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Index to Volume XXX

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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LEADING ARTICLES IN THIS ISSUE

Publisher's Note: The front cover of this journal will hereafter be used to show the contents of the paper, both editorial and advertising. No further display advertising will be contracted for this space.

The Journal of Electricity, Power and Gas tells by picture and story of the wonderful power projects and electrical developments in that growing empire from the Rockies to the Coast.

MATERIALS ADVERTISED IN THIS ISSUE

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX — SAN FRANCISCO, JANUARY 4, 1913 — NUMBER 1

"Snowy Grandeur of Mt. Hood."

PORTLAND RAILWAY, LIGHT & POWER

BY ARTHUR H. HALLORAN.

Portland, Oregon, has enjoyed a solidity and rapidity of growth exceeded only by that of her electric power, light and transit facilities. Indeed, aside from the enterprise of her citizens and her advantageous situation at the junction of the Columbia and Willamette Rivers, where is poured the wealth of the great horn of plenty filled from the granaries, orchards and mines of Washington, Oregon and Idaho, there is no single factor which has contributed more to Portland's progress than electricity.

Generated by the tumbling waters of the Cascades, whose lofty peaks here find their culmination in the snowy grandeur of Mt. Hood, a short transmission gives to Portland the greatest abundance of hydroelectric power. Half as much more is ever ready for service from the great reserve steam plants in the city, by means of which the Portland Railway, Light & Power Company insures continuity of service to its patrons. Countries make railroads, railroads make towns, but power makes cities. A progressive power company constitutes one of the greatest assets of a community.

Such is the Portland Railway, Light & Power Company, which, with the companies of which it is the direct outgrowth, has served the people of Portland for over thirty years. Commencing in 1882, with the installation of a small Brush arc dynamo in Weidler's sawmill, it formed the nucleus for the United States Lighting Company, organized in 1885 to operate a small power plant under the Weidler franchise. In 1899 most of the equipment, which had been added to this original installation from time to time, was moved to the falls of the Willamette River at Oregon City, where power was generated and transmitted 14 miles to Portland by the Willamette Falls Electric Company. This company was reorganized in 1892 as the Portland General Electric Company, of which the present corporation was an outgrowth in 1906.

As a detailed account of this early history appeared in these columns in August, 1905, the present article will be confined to a brief description of the great system.

The original plant on the east side of the Willamette at Oregon City, known as Station "A," has long since been mustered out of the service, though its wheels are still in use in one of the paper mills. Station "B" on the west side of the falls, is the veteran. Station "C," the first steam plant at Portland, has been merged with Station "E," as has likewise "F" with "L," while "D" has also been mustered out. Station "G" is the hydroelectric plant at Cazadero. "H" is a steam plant at Salem. "J" is a small hydroelectric plant at Silverton near Salem. "K" is at Boring, "L" in East Portland, "M" at River Mill on the Clackamas River below Cazadero, "N" at St. Johns, and "O" at Bull Run.

Station "B" at Oregon City.

These ten generating plants have a total rated capacity of 76,980 kw., five being hydroelectric plants with a capacity of 53,230 kw., and five steam driven, aggregating 23,750 kw. Over ninety per cent of the power used is hydraulically generated, the steam plants being used as auxiliaries at time of low water late in the summer.

The high tension transmission system has a total length of 307 miles, operated at 57,000, 33,000 and 11,500 volts. At convenient and strategic points, there are eighteen substations, lowering the voltage for distribution throughout the 800 square miles served, the population of this territory being close to 300,000.

The Portland Railway, Light & Power Company is a $25,000,000 corporation, the control of which is exercised by E. W. Clark & Co. of Philadelphia. C. M. Clark is chairman of the board of directors and J. S. Josselyn president. The vice-presidents are F. I. Fuller, M. S. Hopkins, E. W. Clark and H. L. Clark. At the time of writing it is the only company supplying electric power in any quantity to Portland.

In addition to supplying light and power, this company also operates a street railway system in Portland and interurban lines, connecting Portland with Estacada, Bull Run, St. Johns, Oregon City and Vancouver. Furthermore, it furnishes current for other electric railway companies, including the Oregon Electric, the United Railway and the Salem Street Railway Company. Salem is also supplied with gas.

By far the oldest plant now operated by the company is Station "B" on the west bank of Willamette Falls at Oregon City, five of whose units have been in service since 1894. Seven other generators have been in operation since 1897 and two since 1903. These fourteen machines have a combined generating capacity of 7230 kw., power being transmitted fifteen miles to Portland at 10,000 volts. Novel features of this installation include the employment of a 33-cycle frequency and the dual wheel equipment for varying head.

The former is a relic of the time when the 60-cycle rotary converters had not been sucessfully developed for railway service. This odd frequency was selected as a compromise that would best take care of a mixed load power and lighting service.

The Willamette River, below the falls, is subject to a seasonal height variation of from 20 to 40 feet because of the back water from the flood-swollen Columbia during the spring thaw. The lower river rises as much as 20 ft., whereas there is little change in height above the falls. This necessitated the use of two sets of wheels to drive the main generators, ten of the units being direct connected to 42-in. turbines and belted to 60-in., the wheels being so arranged that they can be operated either individually or together according as the water can be most economically utilized. The smaller wheels are operated under heads varying from 30 to 40 ft., the larger at heads varying from 20 to 30 ft. The details of equipment are shown in the accompanying tabulated statement.

The generator leads pass to hand operated oil switches in concrete compartments at the rear of their respective generator panels, on which are mounted the operating handles for each switch. Thence the leads pass through disconnecting switches to the 10,000 volt buses on a gallery above and to the rear of the switchboard. From these buses two feeders are tapped to the double pole line down the west side of the river fifteen miles to Portland and one to the line on the east side. Another feeder is tapped to seven 750 kw. transformers which step the voltage up to 60,000 for transmission forty miles to Salem and to the substations of the Oregon Electric Railway enroute.

Station "B"—Oregon City.

Buildings: Concrete, timber truss roof, 246 ft. x 30 ft.

Hydraulic Equipment:

Ten 42 in. Victor turbines, cylinder gate, vertical shaft, Replogle governor, 30 ft. head—183 r.p.m. 6549 h.p. direct connected to a.c. generator.
Ten 60 in. Ditto, belted to above 30 ft. head, 126 r.p.m., 13,365 h.p.
Two 48 in. Ditto, direct connected to d.c. exciter, 30 ft. head, 159 r.p.m. 1552 h.p.
Two 51 in. McCormick turbines, cylinder gate, horizontal shaft, Replogle governors, direct connected to d.c. generator.
Two 15 in. Victor turbines cylinder gate, horizontal shaft, for driving circulating pumps.

Electrical Equipment:

Gen. Cap. 6,230 kw. Trans. Cap. 2.594 kw.
7-450 kw. 3-phase, 33-cycle generators, 10,000-volt, 200 r.p.m., revolving armature type, vertical shaft, G. E.
3-500 kw.. 3-phase, 33-cycle, generators, 10,000 volt, 200 r.p.m., revolving field type, vertical shaft, G. E.
2-540 kw., 3-phase, 33-cycle generators, 10,000 volt, 143 r.p.m., revolving field typt, horizontal shaft, G. E.
1-500 kw., 3-phase, 60-cycle generator, 11,000 volt, 100 r.p.m., revolving field type, vertical shaft, Allis-Chalmers.
2-500 kw. generators, 10 r.p.m., 600 volt, vertical shaft.
3-100 kw., 60-cycle, single-phase, transformers, 33,000/10,000-2300 volt.
2-75 light mercury arc rectifier set, air-cooled, single tube.
3-750 kw., 33-cycle transformers, 33,000/57,100-11,000 volt, connected delta,

EVER mindful of the requirements for continuity of electric service the company has provided several auxiliary steam plants in Portland to supplement the current supply from its more distant hydroelectric plants. The original site of Station "C" at the foot of Twenty-first street in North Portland is now occupied by Station "E." This plant has a total generating capacity of 14,050 kw., of which 15,000 h.p. is furnished by steam turbines.

The usual fuel is sawdust, hauled by the company's industrial railway from neighboring mills and conveyer-fed to Dutch ovens. The boilers are also arranged for oil burning. Condensing water is pumped from the Willamette River, on whose west bank the plant is situated, by means of three 16-in. vertical centrifugal pumps. Boiler feed water is obtained either from the condenser discharge or from the river and in emergency from the city mains.

Station "E" at Portland.

The switchboard stands on the main operating floor in front of the two tiers of concrete compartments housing the oil switches, which are operated by remote control from their respective panels. The generator leads are cambric-insulated cables, carried in ducts under the floor. The electrical protective and measuring apparatus is installed in the basement, being of General Electric make.

The frequency at this plant also is 33 cycles, being uniform with that at Station B, Oregon City, and two of the generators at Station G, Cazadero. All the other plants in the system generate 60-cycle alternating current. The lower frequency is used chiefly for railway service through the medium of rotary converters, and the higher for lighting. Direct current is used for power exclusively in all the downtown section of Portland.

This is one of the best-designed steam plants in the Pacific Northwest and is illustrative of typical practice in this section. The building is of reinforced concrete, as is also the 125 ft. stack.

The details of equipment are shown in the following table:

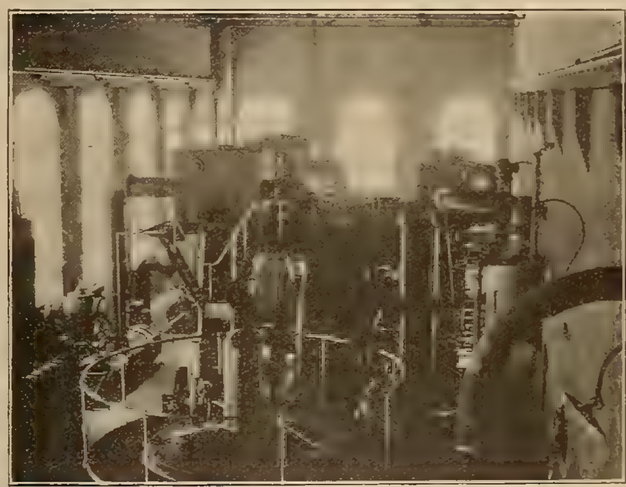
Station "E," Twenty-first and Nicolai.

New Building: Brick, steel truss roof, boiler room 118 ft. x 61 ft., with ell 36 ft. x 71 ft.; engine room 160 ft. x 46 ft., stack reinforced concrete, 230 ft. high, 12 ft. inside diameter.

Old Building: Corrugated iron, wooden truss roof; boiler room 100 ft. x 40 ft.; engine room 100 ft. x 120 ft.

Power Equipment:

Ten 520 h.p. Cahall water tube boilers, 175 lb. pressure, 2 boilers to a battery, 20 Dutch ovens for same, fitted with automatic sawdust stokers and oil burning apparatus. Six boilers fitted with Foster superheaters.
Four 125 h.p. tubular boilers, 100 lb. pressure fitted with Dutch ovens and automatic stokers for burning sawdust only.
Fourteen 100 h.p., ditto.
Two 2500 h.p. Curtis steam turbine, vertical type, 4 stage, 175 lb. pressure, 990 r.p.m., but operated at 1010 r.p.m.
Two 1500 h.p. Willamette Iron & Steel Works engines, marine type, vertical, cross-compound, 26 in. and 53 in. x 36 in., 130 r.p.m., 175 lb. pressure, condensing.
One 125 h.p. Ideal engine, horizontal type, high speed automatic, non-condensing (exciter set).
Two Worthington service condensers for vertical engines, 2300 sq. ft. cooling surface, each ⅛ in x 16 in. x 12 in., steam driven dry vacuum pump and 1/6 in. x 5½ in. x 6 ft. hotwell pump.
Two Worthington condensers for turbines 7500 sq. ft. cooling surface, each 1-10 in. x 18 in. x 18 in. dry vacuum pump and 1-7-½ x 8-½ in. x 10 ft., hotwell pump.
One 10,000 h.p. Curtis steam turbine, horizontal type, 1980 r.p.m. 175 lb. pressure.



Interior of Station "E."

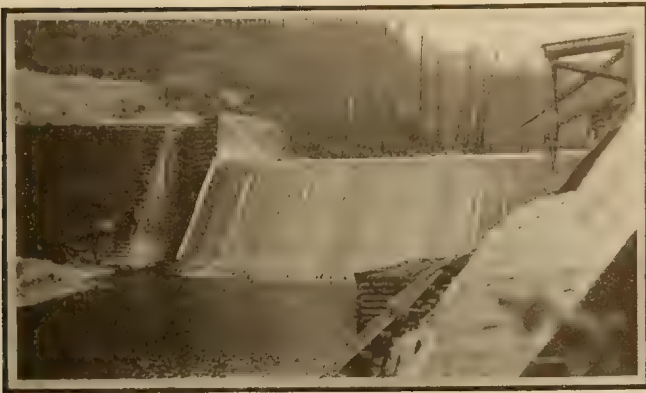
One Alberger counter current surface condenser 20,000 sq. ft. cooling surface.
One 10 x 30 x 24 Alberger dry vacuum pump.
One 4 in. Alberger centrifugal hotwell pump, driven by Curtis steam turbine.
One step bearing pump, 7½ in. x 2 in. x 6 in.
One 1600 h.p. twin Wheelock Corliss engine 32 in. x 60 in., 60 r.p.m., simple condensing, 100 lb. pressure.
One 1000 h.p. Allis Corliss engine, built by Risdon Iron Works, cross compound, condensing, 24 in. x 48 in., 78 r.p.m., 100 lb. pressure.

Pump House:

Three 3-phase, 220 kw. transformers, 10,000/440-volt, air cooled.
Two induction motors, 3-phase, 200 h.p., 33-cycle, 440 volt, 495 r.p.m.
One d.c. motor 600 volt, 125 r.p.m., variable speed.
Two 16 in centrifugal pumps, vertical, Platt.
One 24 in. centrifugal pump, vertical R. D. Wood.
One Worthington fire pump 16 in. x 9 in. x 12 in.

Electrical Equipment:

Gen Cap. 14,050 kw. Trans. Cap. 7558 kw.
Two 1000 kw. 3-phase, 33-cycle generators, 10,000 volt, revolving field type, horizonal shaft, 125 r.p.m.
Two 1500 kw. 3-phase, 33-cycle generator, 10,000 volt, revolving field type, vertical shaft, 990 r.p.m.
One 7500 kw., 3-phase, 33-cycle generator, 5500 volts, 1980 r.p.m., revolving field, horizontal shaft.
One 750 kw. 3-phase, 33-cycle generator, 10,000 volt, 333 r.p.m., revolving field type, horizontal shaft.
One 800 kw., d.c. generator, 550 volt, 120 r.p.m., horizontal shaft.
Six 375 kw., 33-cycle transformers, 10,000/2200-volt, used on 60-cycle lighting.
One 5114 kw., 33-cycle, 3-phase transformer.
One 75 light mercury arc set, ail cooled type, double tube.
Two 400 kw. 3-phase, 33-cycle rotary converters, d.c., 650 volt, 666 r.p.m.
Six 150 kw. 3-phase, 33-cycle transformers, 10,000/401-volt.



Cazadero Dam.

Cazadero Forebay.

GENERATING 14,250 kw., the hydroelectric plant at Cazadero, on the Oregon Water Power division of the company's railway system, 37½ miles southeast of Portland, has been one of the mainstays of the system since it was put into service early in 1907. By means of diversion dam, flume, ditch and reservoir, water from the Clackamas River is delivered through five penstocks to as many turbines driving a.c. generators, whence it is discharged to the river channel.

The dam is a rock-filled log crib, double-planked, 176 ft. wide and 230 ft. long at the base, with 60 ft. rock-filled log bulk heads. The central spill-way of Ogee construction is 170 ft. long and 51 ft. high, delivering the water parallel with the water surface in the lower river and thus preventing erosion. The double row of supply gates, equipped for either hand or motor operation, are contained in a concrete bulkhead in the west side. This dam backs the water up the river about 2½ miles, giving an additional storage capacity of 6,000,000 cu. ft. when 3 ft. flash boards are used, or a total storage of nearly 30,000,000 cu. ft.

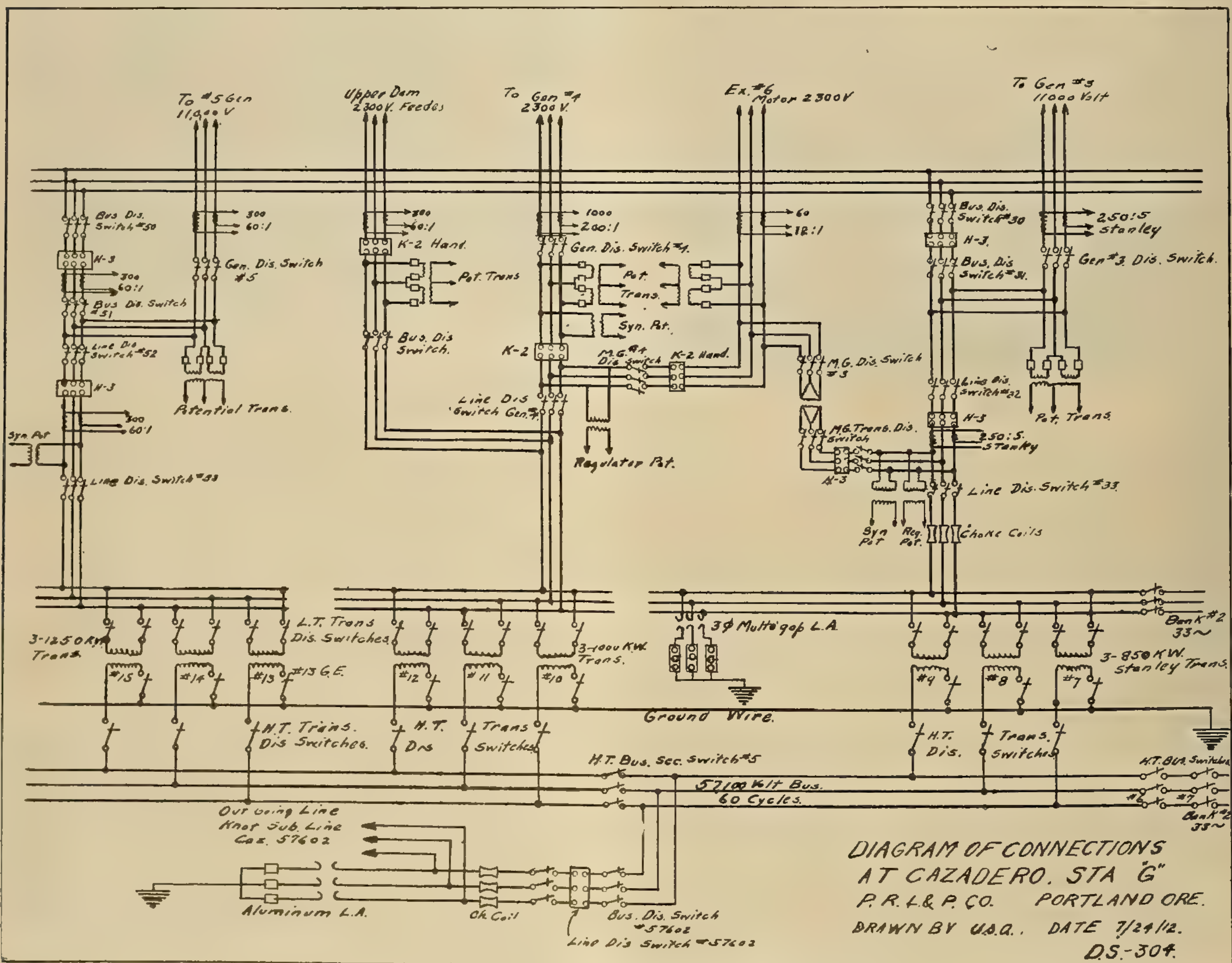


Diagram of Connections at Station "G."

Interior of Station "G."

Transformer House at Station "G."

The flume is 2800 ft. long, 18 ft. deep and 25 ft. wide, and discharges through a concrete outlet into an earth canal 3500 ft. long 35 ft. wide at the bottom, 55 ft. wide at the top and 18 ft. deep. The forebay reservoir covers 50 acres to a depth of 20 ft. At the lower end is a concrete retaining wall 49 ft. high and 280 ft. long with spill-way gates and one 9 ft. and four 8 ft. penstock openings provided with iron trash racks. The penstocks are 145 ft. long with ⅜ to ⅝ in. plates on the 8 ft. and ⅜ to ¾ in. on the 9 ft. and supported at a 45 degree angle on a concrete web and cross wall structure.

The three original turbines were installed in 1907, one in 1909 and the last in 1910. They operate under a head of 138 ft. and in addition to the usual governors are equipped with a special over-speed cut out device. Three 75 kw. d.c. exciters are mounted on the extended shafts of the original wheels and another set is driven by a 150 h.p. Victor turbine.

The slate panel switchboard stands on the operating floor in front of the high-tension switching gallery, there being a panel for each generator and for each exciter, a line totaling panel and one for station circuits. The generator cable leads are carried to the motor operated oil switches on racks in the basement where the field rheostats are also placed, ventilation being secured by a shaft to the top of the building.

The transformer house is across the river from the generating station and contains the transformer compartments and switching room. Multiplex and aluminum cell lighting arresters are installed.

Station "G"—Cazadero.

Buildings: Brick, 50 ft. x 175 ft. x 30 ft. Concrete office and machine shop near; high steel girders, wood roof.

Power Equipment:

1 pair, 5500 h.p. Victor turbines, horizontal type, Lombard governor.
3 pair 5000 h.p. Victor 42 in. high-pressure turbines, horizontal type, Lombard governors.
1-6300 h.p. Victor turbine, horizontal type, Lombard governor.
1-150 h.p. Victor turbine horizontal type, for exciter set.

Electrical Equipment:

Gen. Cap. 14,250 kw. Trans. Cap. 14,850 kw.
2-2500 kw., 33-cycle, 3-phase Allis-Chalmers generators, revolving field type, horizontal shaft, 10,000 volt, 333 r.p.m.
1-2500 kw., 60-cycle, 3-phase, General Electric generator, 10,000 volt, revolving field type, horizontal shaft, 360 r.p.m., rewound from 6600 volts.
1-3750 kw., 3-phase, 60-cycle, General Electric generator, 10,000 volt, revolving field type, horizontal shaft, 360 r.p.m.
3-1000 kw., 3-phase, 60-cycle General Electric generators, 2300 volt, 400 r.p.m., revolving field type—all assembled on one horizontal shaft.
1-400 kw. 33-cycle rotary converter, d.c., 550 volt, 500 r.p.m.
3-150 kw., 33-cycle, single-phase, transformers, 10,000/400 volt.
9-850 kw., 33-cycle, single-phase transformers, 33,000/10,000 volt, 3 used on single 60-cycle.
3-1000 kw. 60-cycle, single-phase transformers, 33,000, 57,100-11,000, 2300 volt.
3-1250 kw., 60-cycle, single-phase, transformers, 33,000/57,100-11,000/2300 volt.

Station "G" at Cazadero.

HALF of the plants in a great system such as this are often held in reserve to care for the possible disablement of other units generating power more economically. This is the case with Station "H" at Salem, which for years was the chief reliance of the company's Willamette Valley Division, being operated in conjunction with Station "J" at Silverton. But since the completion of the forty-mile transmission line in 1908 from Oregon City, it has been shut down and is used for relay purposes only.

Station "H" at Salem.

In addition to the usual service, Salem is also supplied with gas from the company's plant.

Station "H"—Salem.

Building: Brick, wood roof, wood trusses

Power Equipment:

2-100 h.p. water tube boilers, 100 lb. pressure, wood or oil burning furnaces.
6-100 h.p. tubular ditto.
1-500 h.p. Fulton Corliss condensing engine, 150 r.p.m.
1-350 h.p. Lane & Bodley condensing engine, 75 r.p.m.
1-350 h.p. Sioux City, condensing engine, 75 r.p.m.

Electrical Equipment:

Gen. Cap., 800 kw. Trans. Cap. 3745 kw., secondary gen. 1900 kw.
1-400 kw. d.c, generator, 600 volt, 150 r.p.m., horizontal shaft.
1-250 kw., 3-phase, 60-cycle generator, 2300 volt, 450 r.p.m., horizontal shaft.
1-150 kw. motor generator set, 2300/600 volt, 514 r.p.m., horizontal shaft, a.c. end, 3-phase, 2300 volt, 60-cycle, belt connected to engine.
1-400 kw. motor generator set, 2300/600 volt, 450 r.p.m. horizontal shaft, a.c. end, 3-phase, 2300 volt, 60 cycle.
1-1000 kw. frequency changer set, 10,000 volts, 33-cycle, 2300 volts, 60-cycle, 400 r.p.m.
1-500 kw. frequency changer set, 10,000 volt, 33-cycle, 2300 volt, 60-cycle, 400 r.p.m.
1-1000 kw. rotary converter, 6-phase, 33-cycle, 333 r.p.m., d.c.. 600 volt.
2-30 kw. constant current transformers for a.c. lighting system.
3-750 kw., 33-cycle, single-phase, transformers, 33,900/57,000-11,000 volts.
2-150 kw., 60-cycle, single-phase transformers, 16,500-2300 volt connected open delta.
3-367 kw., 33-cycle, single-phase transformers, 500/10,000 -430 volt.
1-75 light mercury arc rectifier set, oil-cooled type, 2 tubes.

JOINING Salem with Station "J" on Silver Creek, near the town of Silverton, are about eighteen miles of transmission line, which in conjunction with a line from Oregon City supplies the light and power necessities of this community. Station "J" is a 250 kw. hydroelectric plant which was built by the Union Light & Power Company in 1902, later being taken over by the Willamette Valley Company and finally sold in 1908 to the Portland Railway, Light & Power Company. Water is diverted from the creek by a 6 ft. dam with 63 ft. spill-way and thence conveyed to a 27 in. double runner, horizontal McCormick turbine, belted to a 250 kw. generator.

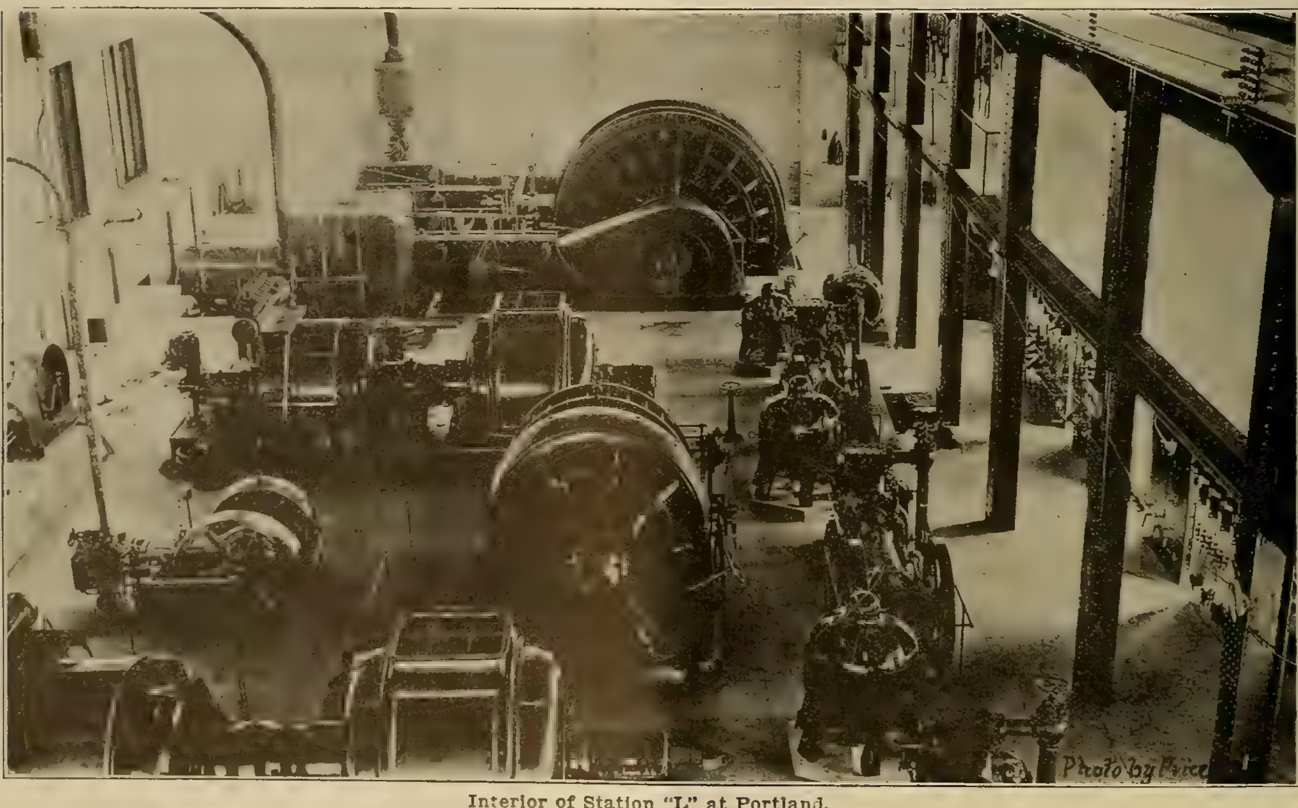
Station "J"—Silverton.

Building: Frame on rubble stone foundation, 60 x 66 ft.

Power Equipment: One low pressure open box, 27 in. McCormick turbine.

Electrical Equipment:

Gen. Cap. 250 kw. Trans. Cap. 300 kw.
One 250 kw., 3-phase, 60-cycle, Westinghouse generator, 2200 volt, 450 r.p.m., revolving armature type, horizontal shaft.
Two 150 kw., single-phase, 60-cycle, transformers, 16,500/2200 volt, connected open delta.



Interior of Station "L" at Portland.

KEEPING a steam plant in reserve is also practiced at Station "K," Boring, which is in regular use as a converter station for the Oregon Water Power Division of the company's railway system. The steam equipment installed in 1904 comprised a 500 h.p Hamilton Corliss engine, rope-connected to a motor generator set. During 1906 and 1907 a similar set was installed, thus giving two 600 kw. Stanley alternators, ordinarily used as motors to drive 400 kw. Bullock direct current generators to which they are direct connected.

Station "K"—Boring.

Building: Corrugated iron; brick wall between boiler room and engine room.

Power Equipment:

Four 100 h.p. Erie tubular boilers with Dutch ovens, 100 lb. pressure.
One 500 h.p. Hamilton Corliss engine, non-condensing, 20 in. x 44 in.; belted to motor generator set.

Electrical Equipment:

Gen. Cap. 400 kw. Trans. Cap. 975 kw., secondary generator 400 kw.
1-400 kw. motor generator set, 10,000 volt, 33-cycle, 400 r.p.m., 550 volt, d.c., rope connected to 500 h.p. engine.
1-400 kw. motor generator set 10,000 volt, 33-cycle, 500 volt d.c., 400 r.p.m.
3-300 kw. transformers, 33,000/29,700-11,000 volts, 3-phase, 33-cycle, water cooled.
1-75 kw., 33-cycle transformer, on 2300 volt feeder.

LATEST of the company's steam plants, except for that bought from the Mt. Hood Railway & Power Company, is Station "L" in East Portland, near the center of the city on the Willamette River, where an ample supply of condensing water is available. The most noteworthy feature of this plant, aside from its up-to-date design, is the foundation, a 3 ft. reinforced concrete slab supported by piles spaced at three ft. centers, many having been driven over 150 ft., and surrounded by a fill of 80,000,000 cu. yds. to equalize the pressure and prevent settling.

Sawdust is used as fuel, being conveyer-fed from a 112 x 54 ft. storage bin which in turn is connected by a double track railway to the mill of the Inman Poulsen Lumber Company. Each boiler is also equipped with a Hammel oil burner for auxiliary firing, either independently or in combination with sawdust firing.

The Curtis turbines are intended for local lighting and transmission, generating alternating current at 11,000 and 2300 volts respectively, the Hamilton engine caring for railway requirements, generating direct current at 625 volts. Space is also provided for a 5000 kw. horizontal turbine.

The switchboard stands on the main operating floor and is suspended by pipe from the high tension switch gallery. The generator leads and the high tension cable are run in fibre or clay ducts imbedded in concrete. The control and lighting wiring is run in metal conduit carried in the station floors. Duplicate sets of bus bars are provided for the 11,000 and 2300 volt machines. Each feeder and machine is connected to both bus bars through two sets of disconnecting switches and remote control motor-operated oil switches. Adjoining the generating station is a reinforced concrete substation with a transforming capacity of 9900 kw. containing three 3300 kw., 3-phase transformers, 33,000/57,100-2300/1100 volts.

Station "L"—Foot of East Clay.

Building: Reinforced concrete, 132 ft. x 160 ft. steel roof trusses, boiler room 58 ft. x 156 ft., engine room 67 ft. x 156 ft., concrete stack 12 ft. in diameter, 125 ft. high.

Power Equipment:

8-440 h.p., 21 x 10 boilers, 175 lb., 2 in a battery, Dutch oven settings fitted with sawdust stokers and oil burners.
One 34 in. and 68 x 54 cross compound Hamilton engine, 90 r.p.m., 3500 h.p.
Two 2000 kw. Curtis turbines, 4-stage, 175 lb. pressure, 1800 r.p.m.
One 120 h.p. single cylinder automatic Skinner engine, 11 in. x 12 in. 275 r.p.m.
One 5000 sq. ft. Alberger counter current surface condenser, horizontal type.
Two 8500 sq. ft. condensers same as above.
Three 10 in. x 16 in x 16 in. Alberger suction valveless hotwell pumps.
One 12 in. motor driven centrifugal circulating water pump.
Two 15 in. pumps same as above.
Three 12 in. x 22 in. x 18 in. Alberger dry vacuum pumps.

Electrical Equipment:

Gen. Cap. 6000 kw. Trans. Cap. 2378 kw. sec. gen. 2000 kw.
One 2000 kw., 3-phase, 60-cycle generator, 10,000 volt, revolving field type, horizontal shaft, 1800 r.p.m.
One 2000 kw., 3-phase, 60-cycle generator, 2300 volt, revolving field type, horizontal shaft, 1800 r.p.m.
One 2000 kw. d.c. generator, 625 volt. 90 r.p.m., horizontal shaft.
Two 1000 kw. motor generator sets, 10,000 volt, 60-cycle, a.c., 500 volt d. c., 514 r.p.m.
Six 367 kw., single-phase transformers, 10,000/23,000 volt.
Four 75 light mercury arc rectifier sets, oil cooled type, double tube.

MORE power has been recently developed on the Clackamas River, two and a half miles below the Cazadero plant, by the construction of a 9900 kw. plant at River Mill. This installation is notable for the rapidity of its construction, considering the exceedingly substantial manner in which it is built, and for the fact that it employs the first Ambursen type

River Mill Power Plant, Power House and Amburson Dam.

of dam for power plant work on the Pacific Coast. All the available power in the river below the Cazadero plant is here developed under a head of 83 ft.

After seven months of preliminary surveying, actual construction was commenced by the contractors, the Puget Sound Bridge & Dredging Company, on June 1, 1910, their work being completed by November 15, 1911. In the meantime the installation of the hydraulic and electrical equipment was so efficiently directed by the Portland Railway, Light & Power Company that the first unit was delivering power to Portland on November 11, 1911, the second unit two weeks and the third just a month later.

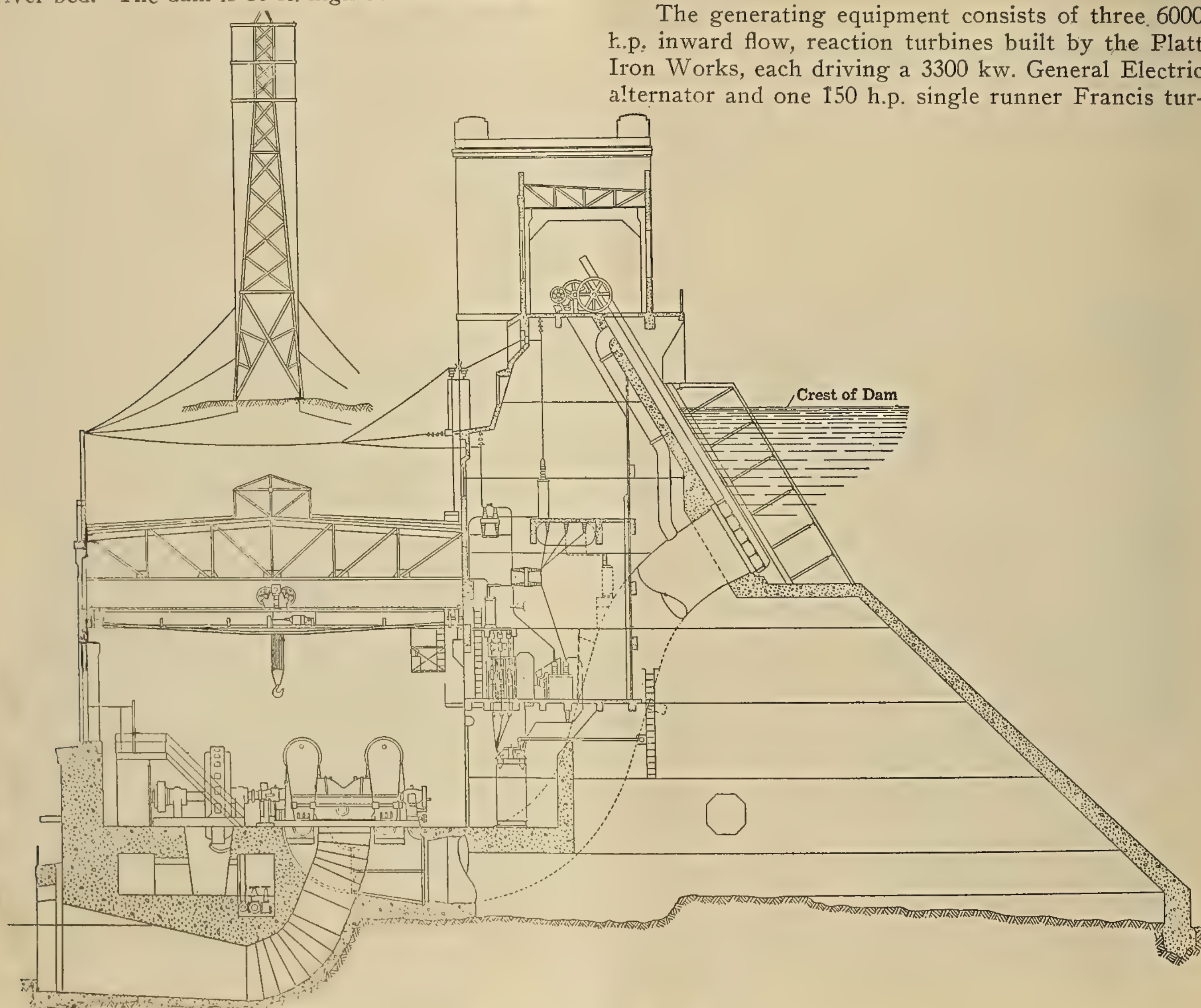
The bed rock is an andesite cut by vertical basalt dykes and so filled with cracks as to require a cement filling or grout, in order to prevent water seepage. Motor operated Davis calyx shot drills were employed to make a regular series of 375 holes through which a mixture of cement was forced to permeate the rock so as to make it water tight.

The Ambursen dam is a hollow structure consisting of a series of parallel concrete walls, or buttresses, supporting and covered with concrete slabs, the base of the down stream side of the spill-way terminating in a curved apron discharging the water parallel to the river bed. The dam is 80 ft. high between water services and 935 ft. long, 407 of which being spill-way. The power house is an integral part of the bulkhead or non-overflow portion on the east bank, the bulkhead buttresses on either side being 15 ft. higher than those of the spill-way. The buttresses are spaced on 18 to 14 ft. centers and taper from 15 in. at the top to a bottom thickness of 48 in. Reinforced concrete beams 18 in. x 12 in. laterally brace the buttresses. The concrete in the buttresses is a 1:3:6 mixture and in the deck and apron a 1:2:4 mixture. Vents to relieve vacuum stresses are provided in the bays between the buttresses, this stress being considerable at times of high water.

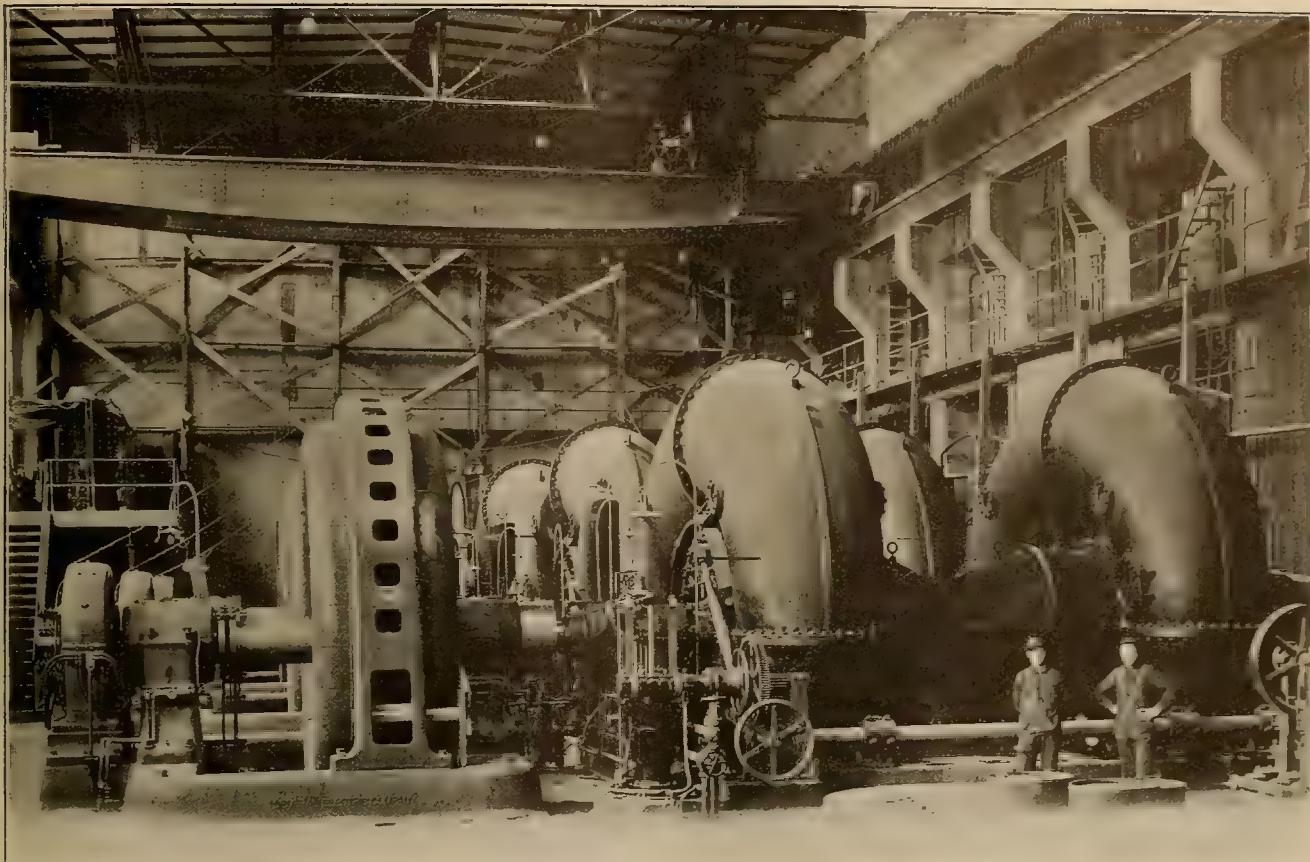
The water may be discharged in three ways: over the spill-way, through the penstocks or through sluice ways under the dam. The last named are hand operated slide gates, designed to discharge 3000 cu. ft. per minute and are used in draining the pond.

Penstocks are 11 ft. in diameter, being made of steel plate varying in thickness from 3/8 in. at the intake to 1/2 in. at the discharge. The supply gates are arranged for either hand or motor control. The trash racks are 5/16 in. steel straps, 3½ in. deep, spaced 1¼ in. apart and supported by a frame work of channel iron and I-beams anchored in the concrete of the dam.

The generating equipment consists of three 6000 h.p. inward flow, reaction turbines built by the Platt Iron Works, each driving a 3300 kw. General Electric alternator and one 150 h.p. single runner Francis tur-



Cross Section Through River Mill Plant and Dam.



Interior of River Mill Plant.

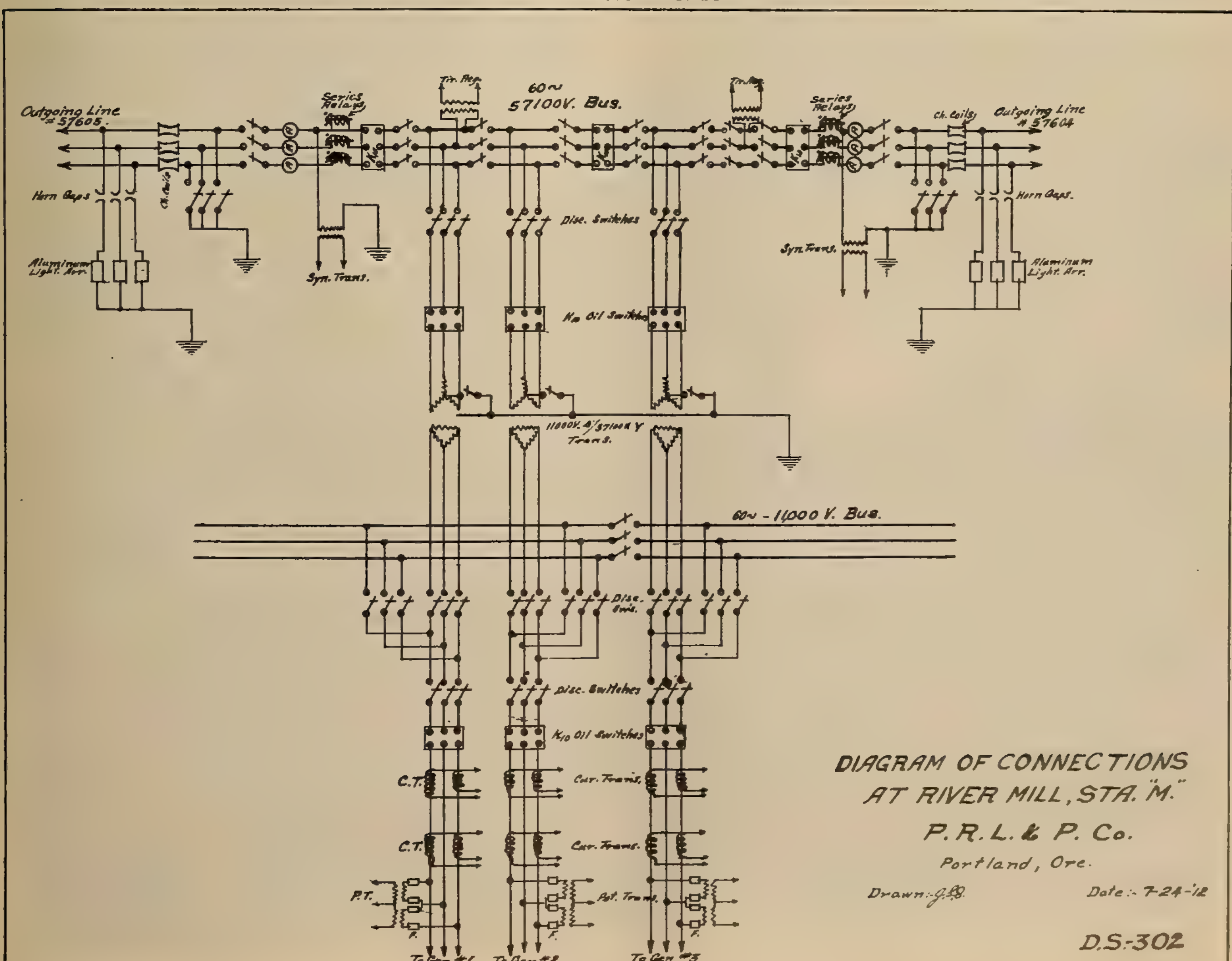


Diagram of Connections at Station "M."

bine operating the exciter under 81 ft. head. In addition to the usual Lombard Type "H" governor, each of the units are operated with an emergency closing device, while the exciter is regulated by a Woodward friction type of governor. The power house has been designed and penstocks, draft tubes, brush racks and sluice gates have been provided for the subsequent installation of two more units.

The switchboard is situated on a gallery at one corner of the plant on the side opposite the oil switches and high tension apparatus. Remote control for the oil switches is provided from the switchboard. The seven panels are of dull slate and equipped with General Electric instruments, there being three machine panels one exciter, one station and two blanks.

The field leads for the generator and the main armature as well as the exciter leads, are carried through 3 in. fibre conduit, supported on racks in the tunnel under the machine, and thence up through the down stream side of the power house to the switchboard. All instrument control and lighting leads are carried in conduits so installed that every conduit drains to a central condulet, thus preventing the conduit filling with water from condensation or other causes.

Station "M"—River Mill.

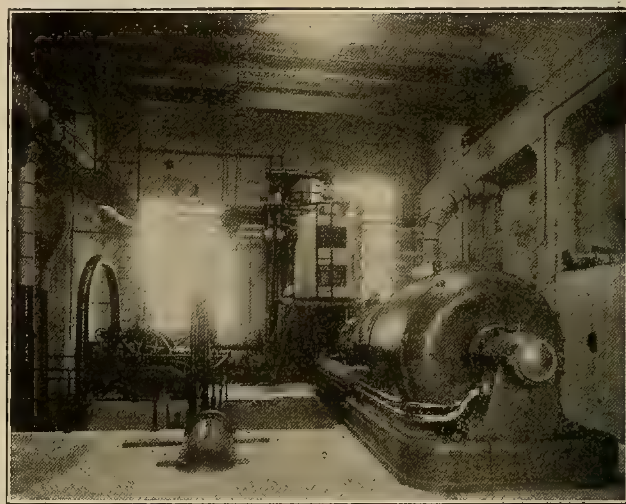
Building: Concrete, 60 ft. x 173 ft., roof supported by steel trusses.

Dam: Ambursen type, length 935 ft., of which 407 ft. is spillway; height 80 ft.

Power Equipment: 3 pair, 6000 h.p. Victor turbines, horizontal shaft, Lombard governors with emergency closing device.

Electrical Equipment:
Gen. Cap.. 9900 kw. Trans. Cap. 10,000 kw.
Three 3300 kw., 60-cycle, 3-phase generators, 10,000 volts, revolving field type, horizontal shaft, 240 r.p.m.
Three 3300 kw., 3-phase, 60-cycle, transformers, 33,000/57,100-11,000 volts, Y connected.
One 100 kw., 3-phase, 60-cycle transformers 11000/230 volts.

NEARLY a year ago the Portland Railway, Light & Power Company took over the properties of the Mt. Hood Railway, Light & Power Company, comprising about 40 miles of steam railway, a 2500 kw. steam plant at St. Johns in North Portland, now known as Station "N," and a 10,000 kw. hydroelectric plant at Bull Run, the terminus of the railway. A double circuit aluminum conductor transmission line, extending from Bull Run to St. Johns, was also included in the transfer.



Interior of Station "N."

The steam plant at St. Johns is equipped with a 2500 kw. generator driven by a Parsons steam turbine built by the Allis-Chalmers Company. This plant also is fitted to burn either sawdust or fuel oil.

Exterior of Station "N" at St. Johns.

Station "N"—St. Johns.

Building: Concrete 61 ft. x 72 ft. x 32 ft. high, roof supported by steel trusses, concrete smoke stack, 189 ft. high, 7 ft, inside diameter at top, 12 ft. inside diameter at base.

Power Equipment:

Three 512 h.p. Stirling water tube boilers set with extension furnaces equipped for hog fuel and oil burners.
One 2500 kw. Allis-Chalmers-Parsons type turbine horizontal shaft, 1800 r.p.m.
One 4800 sq. ft. Wheeler condenser.
One Wheeler centrifugal hotwell pump driven by 5 h.p. Kerr steam turbine.
One 9 x 22 x 12 Wheeler rotative dry vacuum pump.
One 16 in. Wheeler centrifugal circulating pump.

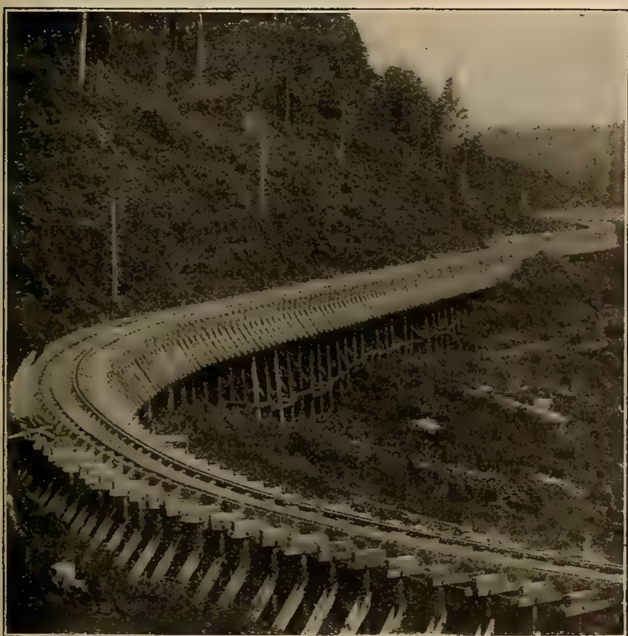
Electrical Equipment:

Gen. Cap. 2500 kw.
One 2500 kw. 3 phase, 60-cycle generator, revolving field, horizontal shaft, 1800 r.p.m.

ON the west bank of the Bull Run River, forty miles from Portland is the Bull Run power house, which the Portland Railway, Light & Power Company bought from the Mt. Hood Railway & Light Company in 1912 before it was completed. Work has been prosecuted diligently during the past year and its 11,250 kw. of hydroelectric power will be ready for delivery in Portland before the end of 1913.

The development has been made possible by a diversion of the water of the Big Sandy and the Little Sandy Rivers to a forebay reservoir, having a capacity of 2103.75 acre ft. A 16 ft. concrete dam has been built to divert the waters of the Little Sandy through 3¼ ft. of timber flume which is also to be supplied with water diverted from the Big Sandy by a 26 ft. dam and carried through three miles of flume and tunnel. The tunnel is 4004 ft. long while the canal provides for several small tunnels 100 ft. or more in length.

Mt. Hood Intake. Showing Three Penstocks and Temporary False Work During Construction.



Mt. Hood Timber Flume.

The forebay intake is of concrete construction in which are installed three 10 ft. balanced butterfly valves, motor operated by remote control from the power house. The penstocks run from the forebay through two tunnels respectively 453 and 250 ft. long, each of the 9 ft. steel pipes branching into 6 ft. penstocks at the end of the second tunnel. Surges are to be cared for by 5 ft. standpipes 42 ft. high, connected through an expansion joint to tanks 15 ft. in diameter and 15 ft. high, the elevation of the surge tanks being about 8 ft. above the water surface and the forebay pond. In the 1500 ft. of penstock length there is a drop of 320 ft.

Oil Switches at Station "O," Bull Run.

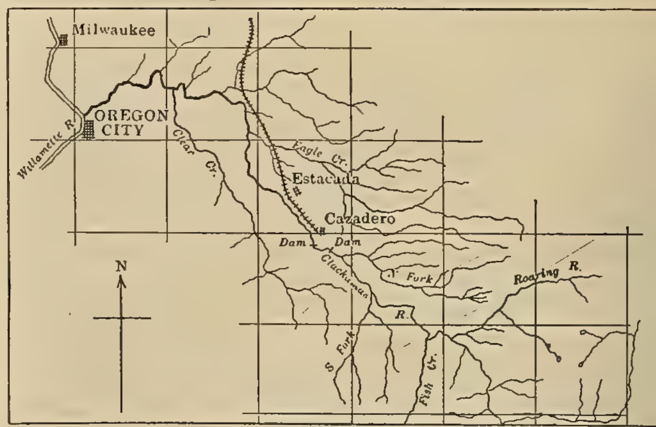
The initial installation at Bull Run consists of one Wellman-Seaver-Morgan 6400 h.p. turbine and two Platt Iron Works wheels, each directly connected to a 3750 kw. Westinghouse generator. These units

Interior of Mt. Hood Plant, Station "O."

are set diagonally, i.e., their axes are at an angle to the power house, for the purpose of avoiding bends in the penstock and to economize space. Water admission is controlled by 54 in. hydraulic lift gate valves with 8 in. by-pass and Lombard governors.

The switchboard stands on a gallery 16 ft. above the operating floor and in front of the oil switches, all the instruments being of Westinghouse make. The exciters are under the switchboard gallery, each consisting of 300 h.p. Victor turbine, with Woodward governor, driving a 150 kw. Westinghouse generator.

The plans call for concealed conduits to carry all wiring. The bus-bar barriers, the switch cells and the transformer comparaments are all of concrete.



Map of Power Development on Clackamas River.

Station "O"—Bull Run.

Buildings: All concrete with roof supported by steel trusses. General building 191 ft. 4 in. x 47 ft. 4 in. x 66 ft. high; 6600 volt switching room 58 x 55 x 54 ft. high; transformer house, 54 x 36 x 24 ft. high.

Power Equipment:
- Two h.p. 42 in. Victor turbines, horizontal shaft, Lombard governors (Platt Iron Works).
- One 6400 h.p. Victor turbine, horizontal shaft, Lombard governor (Wellman-Seaver-Morgan).

Electrical Equipment:
- Gen. Cap. 11,250 kw. Trans. Cap. 21,000 kw.
- Three 3750 kw., 3-phase, 60-cycle generators, 6600 volt, 514 r.p.m. revolving field type, horizontal shaft.
- Seven 3000 kw., 1-phase, 60-cycle transformers, 33,000-18,200-volt.

Exterior of Mt. Hood Plant, Station "O."

THE transmission system is one of the most important factors in maintaining the exacting requirements of urban and interurban railway, light and power service from the distant water power plants upon which this company places its chief reliance. There are in all 280 miles of high tension line, the operating potentials being 57,000, 33,000 or 11,000 volts.

The 57,000 volt lines include the 40-mile pole transmission from Oregon City to Salem, the 27.6-mile steel tower line from the River Mill plant to Lincoln substation, 30.76 mile pole line from Station "G" to Knott sub., and 27.1-mile double pole line from Bull Run to St. Johns. The first named is the property of the Oregon Electric Railway; the second was recently constructed upon the completion of the River Mill plant, and the last was acquired from the Mt. Hood Railway & Power Company.

The line from River Mill to Lincoln substation has 310 towers with the standard spacing of 500 ft. Each tower is constructed of galvanized angles, channels, etc., bolted together, giving a self supporting or inflexible type, designed to carry two power circuits of three conductors each, one 2-wire telephone circuit and one ground circuit. The insulators are made up

Map of Portland Railway, Light & Power Company's High Tension Transmission System.

Cazadero 60,000-Volt, 60-Cycle Transmission Line.

Twin Poles Near Station "L."

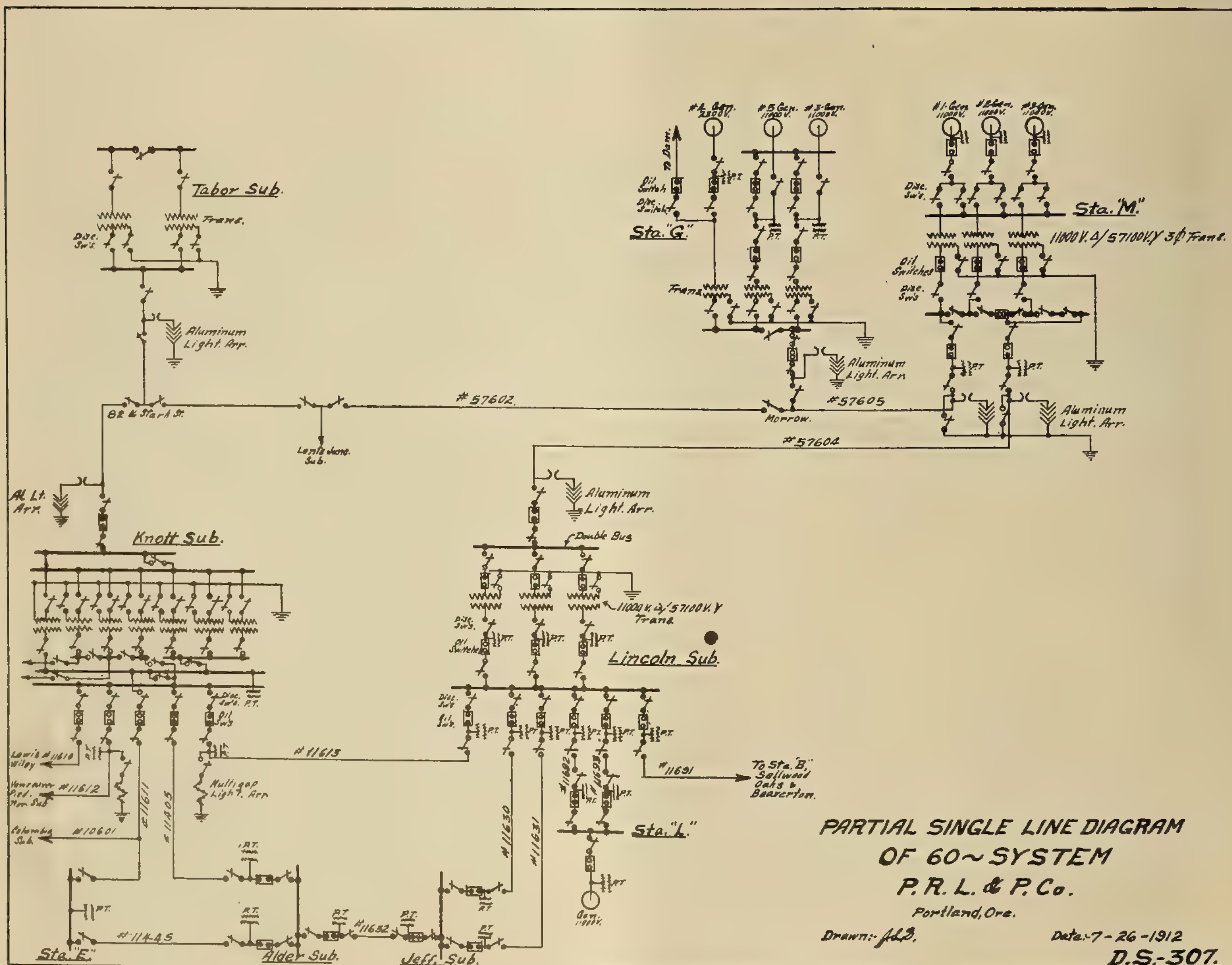
Pole Line Construction in Portland.

Distributing Lines.

of three single-phase unit, suspension type. The conductor has 250,000 c.m. hard drawn stranded copper. The double pole line from Bull Run to St. Johns is to be operated at 57,100 volts, the conductor being stranded aluminum equivalent to No. 000 copper.

The double 31 mile pole transmission from Cazadero to Portland is operated at 33,000 volts while the lines from Oregon City to Portland are a 11,000 volt transmission.

SUBSTATIONS of this system may be considered under three sub-divisions: interurban railway, those around Salem and those supplying Portland. The substations along the line of the Cazadero branch of the Oregon Water Power road comprise those at Estacada, Eagle Creek, Gresham, Boring and Lents. The first is solely a transformer substation, stepping down from 33,000 to 2300 volts for local lighting through a 25 kw. transformer. The others are equip-



Partial Single Line Diagram of 60-Cycle System.

ped with 33 cycle rotary converters, furnishing direct current for railway use, Eagle Creek and Gresham each having one 400 kw. machine, and Lents one 1000 kw. and two 400 rotary converters. The equipment at Boring has already been noted under Station "K."

Each station is housed in a brick building with concrete foundation. The Oregon City branch of the O. W. P. is supplied with direct current at 600 volts from a 1000 kw. coverter set in the Sellwood substation, which also furnishes current for local incandescent and arc lighting.

The Oaks, on the railway line, is a 400 kw. transforming station, supplying 110 and 220 volt current tc a park of that name on the banks of the Willamette. In addition to the transforming equipment and station at Salem, transformer stations at Woodburn and Mt. Angel supply the current to these towns.

The substations in Portland and suburbs transforming current for lighting purpose and converting for railway and power service, are the Alder street and Jefferson street in West Portland and the Lincoln, Tabor, Knott, Columbia, and Northern as well as St. Johns on the east side of the Willamette. The several substations on the east side of the river are tied together with a 10,000 volt, 33-cycle cable looped into each station in such a way that the energy may be derived from two directions, thus allowing any section to be cut out at any time for repairs. The Alder street substation is situated in the basement of the Electric Building at Seventh and Alder streets, and is the main distributing point for the system.

Direct current for 600 volt railway service is supplied by two 1000 kw. rotary converters. Seven 1000 kw. motor generator sets give direct current at 250 volts for power use, and one 500 kw. motor generator supplies direct current at 500 volts for commercial service. This station has a total transformer capacity of 2387 kw. and secondary generating capacity of 10,255 kw. The storage battery set of 132 cells is capable of supplying 30,000 amperes for 10 minutes.

The Jefferson sub. has a transformer capacity of 2742 kw. and secondary generating capacity of 5405 kw., direct current being supplied at 600 volts for railway service by means of motor generator sets.

Substations of Portland Railway, Light and Power Company.

Eagle Creek. Knott. Northern.
Alder. Knott Interior. Sellwood.
Jefferson. Gresham. Tabor.

The Knott is the largest of the East Portland substations, supplying 4000 kw. of direct current for railway service and 15,028 kw. transforming capacity.

The Lincoln sub. is the Portland terminal of the steel tower line from the River Mill plant and steps down from 57,000 volts through individual 3-phase 3300 kw. transformers star connected to 11,000 volts.

The Tabor sub. has a transforming capacity of 2764 kw. and secondary generating capacity of 1000 kw.

The Columbia sub. has a transforming capacity of 8276 kw.

Northern sub. has a secondary generating capacity of 800 kw. and transforming capacity of 2532 kw. The St. Johns sub. at Station "N" has a transforming capacity of 1500 kw., containing two 750, 3-phase, 60-cycle transformers.

There is also a substation at Vancouver, Wash, having a transforming capacityy of 1188 kw.

Distribution and General Utilization.

Electric power is distributed through the city of Portland and suburbs at a potential of 2400 volts. The city has been divided into districts with a separate feeder to selected centers of distribution in each district. The potential is stepped down to 240 volts for a three-wire distribution by means of transformers carefully placed throughout the district and the secondary system as far as possible is tied together.

The Portland streets are illuminated by 3103 magnetite arc lamps of which 171 are multiple, and the balance series, there also being 1169 commercial arcs. These lamps are supplied with current from 75 light mercury arc rectifier sets and constant current transformers which are operated directly from 10,000 volt, 33-cycle, and 60 volt, 3-phase generating system.

The incandescent lighting load totals 757,751, 16 c.p. equivalents, on a.c. and d.c., 220/110 volt circuits, while the motor load totals 39,216.07 h.p., 220 volt a.c. and 500 volt d.c.

Street Railways.

Portland's first electric railway was built in 1894, when Station "B" was equipped to furnish current for its operation. Within the next few years, other companies entered the traction field until in 1901 there were four independent concerns operating about one hundred small cars to carry about 50,000 passengers daily. Two of these companies were later consolidated and in 1906 all were absorbed by the Portland Railway, Light & Power Company, which now operates over five hundred cars over 200 miles of track to carry as high as 300,000 passengers daily. In addition there are 76 miles of interurban railway. For the following details on the railway system, the author is indebted to H. M. Clark of the company's railway department.

The railway system of the Portland Railway, Light & Power Company covers 272 miles of equivalent single track, 143 miles of which is standard gauge (4 ft. 8½ in.) and 129 miles narrow gauge (3 ft. 6 in). This is exclusive of yard and carbarn track. This trackage represents the consolidation of the narrow gauge city and suburban lines in and around Portland (formerly the Portland Railway Company) with the standard gauge suburban and interurban lines of the Oregon Water Power Company in which is now included the recently acquired interurban line to Bull Run, formerly the Mount Hood Railway & Power Company. The general operating divisions are two in number, viz: city system and interurban system.

City System.

The city division embraces thirty-three lines with a total of 196 miles of track—6 lines are standard gauge, the balance being 3 ft. 6 in. Half of the total closed city equipment in Portland is pay-as-you-enter type which has been adopted as standard. The other principal types are a three compartment, double truck, closed car of local design and construction and a 45 ft. double truck American Car Company car of ordinary type.

The pay-as-you-enter car was first introduced in Portland in 1909 and since that time all cars purchased have been of this type. There is some little difference in the dimensions of the narrow and standard gauge cars but the general design is the same, both being made by the American Car Company.

The three compartment closed narrow gauge car for city service is of local design and construction, the company having quite a number in use. The other type of closed city car is manufactured by the American Car Company.

City ordinance requires that all cars 35 ft. in length and over be equipped with air brakes. All cars are equipped with Consolidated Heating Company's heaters, in accordance with the city ordinance that all cars be heated.

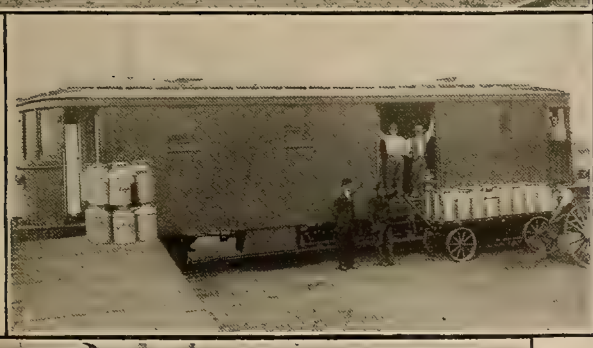
Included in the lines of the city system there is an interurban line from Portland to Vancouver, a distance of 14½ miles. This line is 3 ft. 6 in. gauge and the type of car is different from any others on the system. The cars are operated in trains of two consisting of a four motor car pulling a trailer. This line terminates at the Oregon shore of the Columbia River where passengers are transferred to a ferry boat owned and operated by the company and carried across the Columbia to Vancouver, Washington.

There are two lines on which magnetic brake equipment is used, viz: the Portland Heights and Council Crest line and the Kings Heights line; the latter is of comparatively recent construction. The Council Crest line is noted for its scenic features and attracts much tourist travel in season. In the course of the trip to Council Crest the route climbs the heights to the south and west of the city on an average grade of 5.5 per cent, the maximum grade being 12 per cent. From Council Crest, the highest point in the range of hills surrounding the city, elevation 1200 ft., is a magnificent view of the surrounding country. With the aid of glasses in the observatory of the amusement park there, the glacial formations on the snow capped mountains of Mount Hood in Oregon, and St. Helens, Mt. Adams and Ranier in Washington may be studied. The cars in this service are of semi-convertible type, Brill design and construction. They are 40 ft. in length and have a seating capacity of 40.

Interurban System.

The interurban system covers 76 miles of standard gauge track, over which both freight and passenger service is operated. The longest line is between Portland and Cazadero, a distance of 37½ miles; other lines are: between Portland and Oregon City, a distance of 15 miles; between Montavilla and Bull Run, a distance of 21 miles; between Linneman (a station 10 miles out of Portland on the Cazadero line) and Troutdale, a distance of 7 miles.

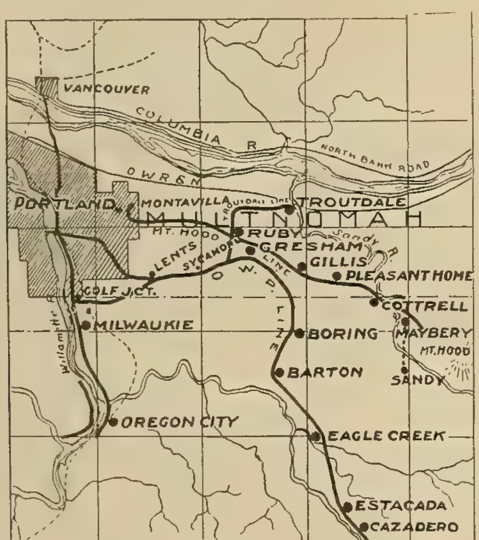
The territory immediately adjacent to the Cazadero line is fast developing into a rich agricultural country, while the country in the vicinity of this line has long been in a high state of cultivation. From a point 17 miles distant from Portland, hourly service is maintained, while beyond that two-hour service is rendered. The trains operated range from 2 to 5 cars in general practice, and excursion business has been taken care of in trains as large as 10 cars. This



1. One Type of Interurban Car.
2. Type of P. A. Y. E. Car, City System.
3. Three-Compartment Car, City System.
4. Type of Closed Car, City System.
5. Officials' Car on Interurban System.
6. Freight Locomotive Built in Company's Shop.
7. Express and Baggage Car on Interurban System.
8. Car Used on Vancouver Line, City System.
9. Interurban Train—Cazadero Line.
10. Special for Trainmen's Picnic.

line is the source of a heavy carload freight business —cordwood predominating. Brick, fir logs, gravel, crushed rock and other commodities are also handled as well as large shipments of merchandise. The majority of all wood shipments into the city of Portland are brought in over this track.

Between Linneman Junction and Troutdale, a branch of this line is operated, touching at Fairview where this company has physical connection with the O. W. R. and N. While at this time the passenger and freight business is not excessive, it is expected that in the near future more business will arise, particularly as the freight business from the Mount Hood line will be operated over a portion of this track. A certain amount of wood used in the manufacture of paper is also shipped from Troutdale, which supply is drawn from the banks of the Columbia River. Outside of five miles of double track between Portland and Golf Junction, a distance of 5.36 miles, single track operation prevails. Sidings are situated at such places as will properly take care of the operation. Between Golf Junction and Lents Junction, a distance of 5½ miles, the track is protected by block signals. Beyond that point block signals have not been installed.



Map of Clackamas Drainage.

The line between Portland and Oregon City runs for a part of the way through beautiful residence districts, taking in several small and beautifully situated towns, and through quite a rich farming country. The holdings of the farmers are comparatively small on account of the high land values. Oregon City, while not the terminus of the line, is the main point from which trains are operated, and has a population of about 5000. Beyond the falls at Oregon City, is a small residence section known as Canemah, the residents being principally employed in the paper and woolen mills in Oregon City. This company owns the park known as "Canemah Park," situated between Canemah and Oregon City at an elevation of 100 ft. The districts bordering along the line are heavily settled, and passenger business is extremely heavy for an interurban line. Thirty-minute service is maintained throughout the day, and is augmented by tripper service running a distance of 7 miles to the town of Milwaukie, during the rush hours.

The line between Montavilla and Bull Run, known as the Mount Hood Division, was originally intended to reach a point in the vicinity of Mount Hood. It was taken over by this company with the Mount Hood Railway & Power Company in the spring of the present year. At this time the line is being operated by steam locomotives—three in number, but it is expected that electrification will take place in the near future. The line handles both passenger and freight business.

The entire interurban system is operated under standard railroad rules with such modifications as are necessary to meet local conditions. Agents are located at various points on the line, each covering a certain territory, ranging from about 8 to 10 miles of track.

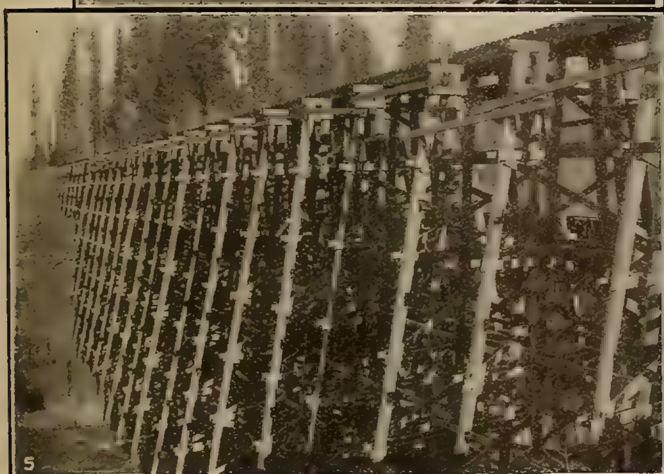
The yards, which are the terminals for freight train operation are situated at East Portland where from 100 to 200 cars are handled daily. At this point also the company has physical connection with the Southern Pacific Railway Company, where carload business is interchanged. The freight service is taken care of by three freight trains daily, and in addition a yard crew takes care of the switching and serves industry tracks. The trains run as high as 40 cars.

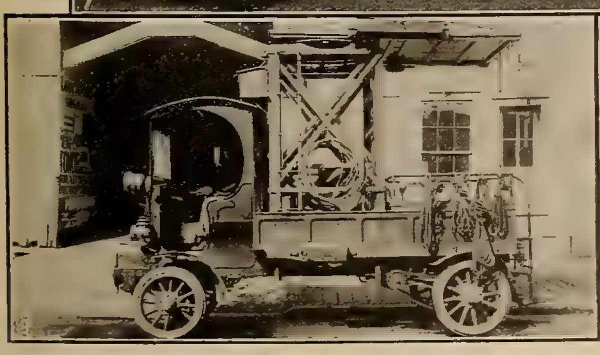
Train dispatching is handled by telephone. Recently the selective ringing type of the Western Electric Company has been installed on both the Mount Hood and Cazadero lines, and will in all probability be extended to cover the Oregon City line. The selective system of ringing is much quicker and more accurate than the old code system of ringing by hand and possesses the added advantage of ringing only the station desired rather than all the stations along the line. Stations can be called at great speed inasmuch as the mechanism operates at the rate of 10 impulses per second making it possible to call station No. 1 in 1/10 of a second, Station No 5 in ½ of a second, etc. The selector key in its operation not only selects the particular station wanted but also automatically rings the bell from two to three seconds. This ringing can be prolonged by the dispatcher through the operation of the strap key which is a part of the circuit. The dispatcher receives an audible signal through his receiver while the bell is ringing at the station called.

The company has eight four-motor locomotives for freight service on interurban lines. They are of the sloping cab type and are all equipped with multiple unit control, which is very desirable for this service in that the motive power may be increased to meet the demands of heavier trains, by merely coupling two locomotives to run as a unit, controlled by one motorman.

Shops.

The company has recently completed erection of buildings for the consolidation of all its car shops at one point, thus obtaining far greater efficiency than was possible formerly with several shops widely separated. The combined shops combine the latest thought in construction and shop operation—the facilities provide for any work from the most minor repair to the construction and equipping of the modern city car or interurban car or locomotive.





1. Club Rooms in Piedmont Car Barns.
3. Freight House and Dock on Willamette River.
5. Trestle on O. W. P. Line at Eagle Creek.
7. Construction Train at Gravel Pit.
9. Emergency Line Truck.

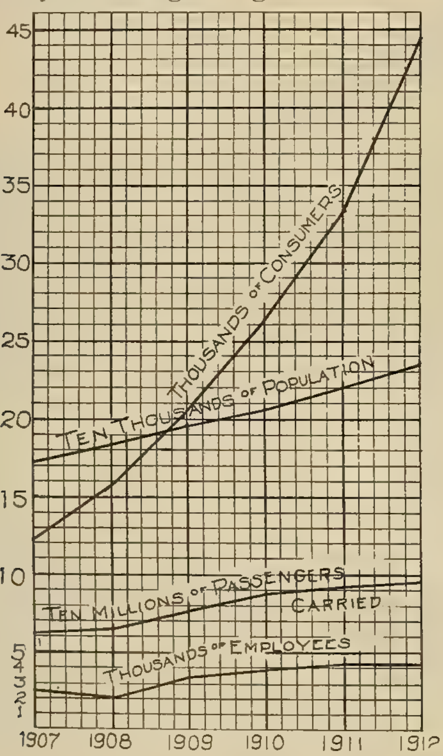
2. Pool and Billiard Room for Employees.
4. Freight House at East Portland Terminal.
6. Cazadero Track Near Boring.
8. Ballast Train With Freight Locomotive.
10. New Concrete Warehouse at East Portland.

Exterior of New Center Street Shops.

The shop consists of a group of four buildings of brick and concrete construction, one of which is used as a storeroom for all supplies necessary for the road. The machine shop, blacksmith shop, armature room, air room and motor and truck repair shop are housed under one roof.

Conclusion.

This is the story of an undertaking to which no conclusion is in sight. The Portland Railway, Light & Power system is growing faster than Portland

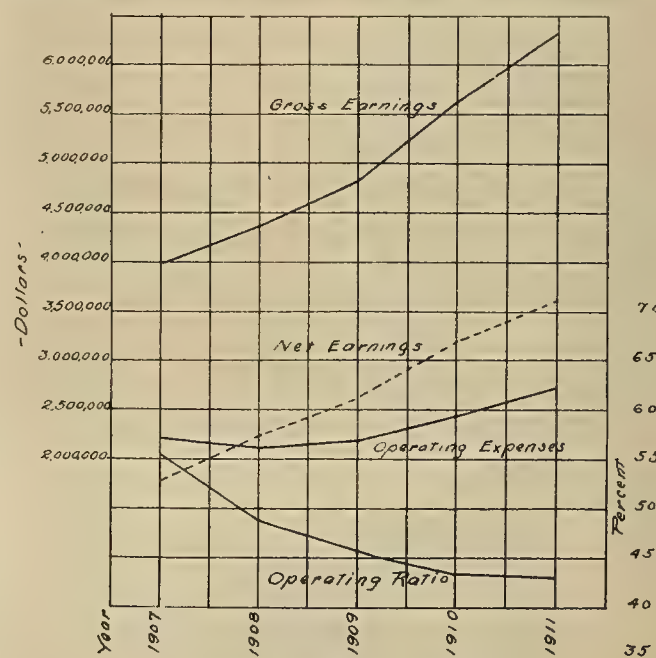


Graphic Illustration of Company's Growth as Compared to Increase in Population.

itself, a city whose population more than doubled between the census of 1900 and 1910. A better showing was made by only four other cities in the hundred thousand class. Portland, as one of the leading wheat and timber ports of the United States, has a well-earned reputation for conservation and has proven an attractive field for investment. Its postal receipts have averaged over one million dollars for the past three years, its building permits over eighteen millions and its bank clearings over five hundred and fifty millions annually.

Meanwhile, since 1900 the number of light and power consumers has increased more than one hundred fold. Although the company has expended nearly twenty million dollars for betterments and additions to property during the past four years, the present demand is so close to the available supply that new hydroelectric development will soon be necessary on the upper Clackamas River.

This phenomenal growth is in a large measure due to the progressive policy pursued by the company. The aggressiveness of business getting is surpassed only by the energy of business holding. Every endeavor



Company's Financial Showing.

has been made to please the public by the best service and lowest rates as well as by the fairest treatment. A most careful study is made of the welfare of each employe and this is reflected in the coutesy exhibited by every representative of the company.

Truly has it been said that an institution is but the lengthened shadow of a man. In the Portland Railway, Light & Power Company that man is its president, Mr. B. S. Josselyn, beloved and respected by every citizen of Portland. During the five years and more which he has represented the interests of E. W. Clark & Company at Portland, his life has been one of service, an inspiring example to every official and employe of the company. He is the fountain-spring of the fine spirit of co-operation and sympathy for which his company is famed and he is responsible for the magnificent financial condition which has been developed under his administration.

B. S. Josselyn

"Josselyn Hall," Mt. Tabor.

ELECTRICAL PUMPING AND IRRIGATION

RETAINING WALLS FOR CANALS.

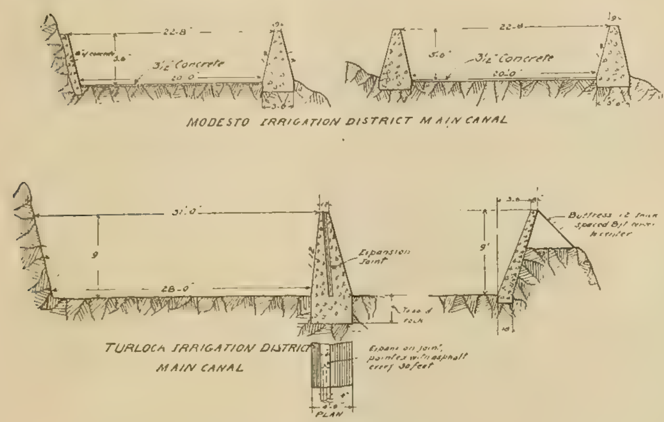
BY B. A. ETCHEVERRY.

Concrete retaining walls may be used to advantage for the following classes of canal construction:

First—Where the slope of the ground is too steep to allow the construction of a canal in cut, as on a sidehill.

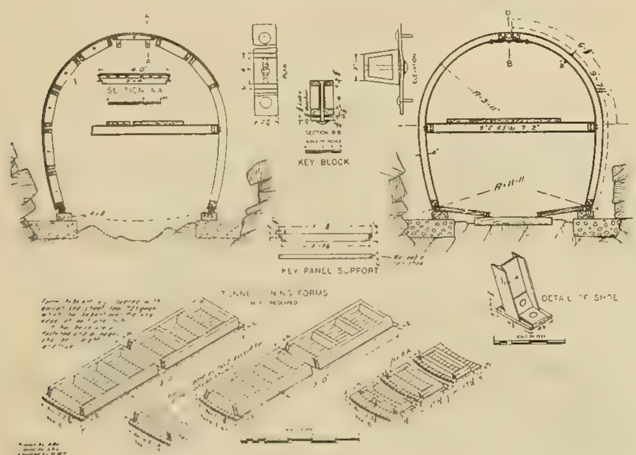
Second—Where the side slopes of the cross section are steeper than the ground will stand and must be retained with a wall.

Third—Where a canal in embankment is not desirable.



Typical Retaining Wall Cross-Section on Modesto and Turlock Irrigation Canals.

The Modesto and Turlock irrigation systems have several thousand feet of concrete walling on the upper part of their diversion lines near the headworks, where the canals skirt the hillsides. Because of the steep slopes of the hillsides, the canal could not be made entirely in cut and a great portion had to be built originally with an embankment on the lower side, and where too steep for the embankment a wooden bench flume was constructed. The embankment was a source of expense and required careful watching to avoid



Typical Sections for Tunnels.

breaks. The flumes decayed rapidly and their cost of maintenance was high. For these reasons, concrete walling has been used to replace the bench flumes and to retain the earth on the embankment side of the canal. The walls extend below the bed of the canal down to solid foundation and where seepage is liable to occur and undermine the wall a bottom lining of concrete is used. On the uphill side where the rock is fissured or where the material will not stand the erosive action of the water, a sloping concrete retaining wall is built. Where the wall has no backing it is designed as the lower wall to resist water pressure.

A few typical sections of the Modesto main canal and the Turlock main canal are given. The Modesto sections have a floor lining of $2\frac{1}{2}$ inches thick of concrete because of the pervious bed. Part of the Turlock walling consists of an inclined retaining wall supported with buttresses 12 inches thick, spaced 10 feet apart, and extending down to solid foundation. Another section of the walling consists of a retaining wall with expansion joints every 25 feet. These joints were made by placing a temporary dam with a V-shaped tongue between the wooden forms. When the concrete had hardened sufficiently the V-shaped dam was removed and the joint painted with an asphalt mixture before the next section was started. At the apex of the V an iron rod was placed. This rod was removed when the next section was finished and the

Concrete Retaining Wall on Modesto and Turlock Canals.

hole filled with hot asphalt. On the Modesto side, although no expansion joints have been provided, no serious cracks have appeared.

Tunnels.

A tunnel may be necessary:

First—Where it is more economical to run through a ridge than to go around it.

Second—Where the perpendicular cliffs or steep hillsides of a canyon make the construction of an open canal or flume impossible or not economical.

Size of Tunnel.

To make the cross section of a tunnel as small as possible and where the available fall will permit it, the velocity given to the water must be as high as the material will stand without erosion. Where the tunnel is part of a hydroelectric system the decreased cost of a small tunnel on a steep grade must be properly balanced with the value of the loss of power produced by steep grade.

Form of Section.

The best form of cross section is one which is convenient to construct and economical in volume of excavation and in cost of lining where canal is

to be lined. In some material it is not possible to blast a regular section, but where the material can be excavated or blasted to a definite form or where the canal is to be lined with concrete the form may be circular, oval, horseshoe or rectangular. The circular form gives the smallest perimeter for a given cross section; next to this is the oval form, then the horseshoe and the rectangular forms. The horseshoe and rectangular sections are more easily constructed and are frequently employed.

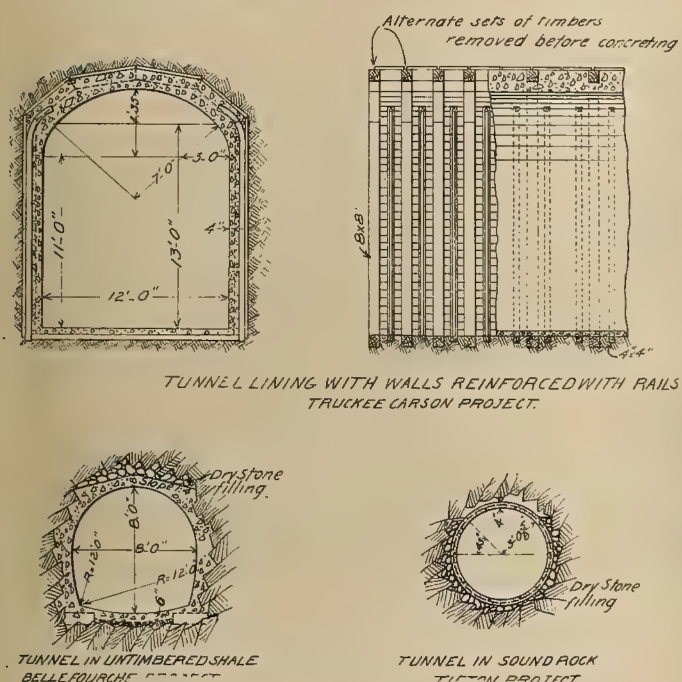
Lining of Tunnels.

The lining of a tunnel may be necessary:

First—To prevent seepage if the tunnel runs through porous material or fissured rock.

Second—To allow a smaller cross section by increasing the carrying capacity.

Third—Where the material will not stand and it is necessary to hold the material up.



Details for Tunnel Lining Forms.

A safe velocity is 10 ft. per second and where the water is free from silt or sand a higher velocity may be used.

For circular tunnels cement pipe has been used in southern California. The ordinary cement pipe is laid on grade, the joints made with mortar, and the pipe carefully backfilled. On the Tieton project large size pipes 8 ft. in diameter and 2 ft. long are used to line the tunnels, the sections are hauled by a cable line to the portal of the tunnel and placed on grade in the tunnel. Where the tunnel is lined with cement pipes made in advance, the backfilling must be very carefully done to prevent settling and cracking of the lining at the joints. For a large size tunnel it is usually more economical to line it by placing the concrete directly on the surface of the tunnel.

The rectangular section with inverted arched roof is adopted by the Reclamation Service on many of its projects. This form facilitates the construction; the excavated material can be hauled in cars running on tracks and the side lining and bottom lining are easily applied. The types of lining may be of three kinds depending on the material through which the tunnel is excavated:

First—In hard rock, where no timbering is necessary, and a coat of cement mortar is plastered on the rock.

Second—In firm soil, where no timbering is necessary, or where temporary timbering can be removed when the lining is put on.

Third—In loose rock or soil which requires timbering either on roof or roof and sides. The concrete lining is put on, the timbers remaining in the concrete.

The thickness of the lining may range from 2 to 8 in. when in compact rock and 8 to 12 in. when in loose earth or fissured rock.

Truckee-Carson Project Tunnel Lining.

On the Truckee-Carson project, Nevada, four tunnels with a total length of 2937.7 ft. have been constructed according to methods two and three. The carrying capacity of these tunnels is 1200 second feet

Portal to Tunnel on Tieton Main Canal, Washington.

with a depth of water of 13 ft. and a velocity of 8.10 ft. per second. The tunnel sections have vertical sides 12 ft. apart and a horizontal floor. The roof is a three centered arch, 3.35 ft. high for three of the tunnels and 4.35 ft. high for the other. The height at the center is 15.35 with maximum depth of water of 13 ft.

When method one is used, the timbered sets are 8 in. x 8 in. lumber forming an arch of 4 segments, the sets are spaced as widely as deemed safe, depending on the material encountered, any vary from 2 to 6 ft. on centers. The concrete lining on the bottom is 4 in. thick, on the sides the lining is 12 in. thick (4 in. thick at the timbers) and at the center of the arch 16 in. thick. Tunnel No. 3, which is 1515 ft. long, has a thicker arch lining than the other three tunnels. For part of its length, where the ground was very loose, the concrete lining was reinforced with railroad rails. The timber spacing was 4 ft. for most of the tunnel. With the exception of 150 ft. the material through which the tunnel was excavated was silt and cemented gravel that worked easily. The actual unit cost of the tunnel is as follows:

Cost per lineal foot of driving and timbering	$23,764
Cost of concreting per cu. yd. excepting cement	6,596

(To be continued.)

READINESS TO SERVE METHODS

ELECTRICITY IN THE DAIRY AND CONSERVATION OF FARM PRODUCTS.

BY R. B. MATEER.

The dairy on many of the large ranches is susceptible to economical operation by the use of the small motor and to a greater degree than any other portion of the farm where manual labor was at one time a necessity.

In the search for labor saving devices, many practical motor applications resulted, securing to the farmer maximum economy. Compare, if you please, the former method of milking the cows, the tiresome and continuous opening and closing of the fingers, the uncomfortable position of the milker and the lack of sanitary surroundings, with the now successful milking machine, its cleanliness, its ease of operation and the reduction in hired help, rendering the dairyman independent. Under ordinary conditions, the labor saved aggregated from thirty to forty per cent and permits of the employment of more responsible and better salaried men.

Fig. 1. Motor Operated Vacuum Pumps for Milking Machine.

One of the successful milking machines consists of the can or receptacle and the machine. The milking machine consists of a cover which fits air tight on the receptacle by the use of a small rubber gasket Mounted on the cover is a frame, a pair of vacuum pumps and two double valves. The pumps are operated through a crank shaft and a small electric motor. Connected with the shaft is a drive which places the double valves in motion. A small gauge indicates the degree of vacuum in the can and a needle valve under the small gauge controls and regulates the amount of vacuum necessary to milk the cows. Attached to the double valve is a rubber tubing and the teat cups. It is claimed that in an hour's time 30 cows can be milked, yet a conservative estimate, when the labor of the man who removes the milk is considered, would be from 10 to 12 cows per hour.

The milk secured is then separated. A machine with a capacity of 1300 pounds per hour and operating on a 1½ horsepower motor requires only 0.0386 kilowatt hours per 100 pounds.

Again where it is desired to market dairy products the churn may be used, and at a comparatively small cost a fancy table article produced. A 100 gallon churn belted to a motor of two horsepower capacity requires approximately 0.617 kw.-hr. per 100 pounds at a cost of $0.01851 exclusive of labor and depreciation or $0.24 for churning and working the butter, when such cost items as labor, etc., are included. From this it is evident that electric service is not alone the servant of the large dairyman, but also of the small ranchman.

Conservation.

Thousands of acres are planted with bearing trees of many varieties and an equal number of acres are producing vegetables such as potatoes, and beets, the yield per acre surpassing the average season's consumption. Shall the fruit go to waste, the vegetables decay, or will the surplus be utilized so as to produce a food for man and cattle? It is possible to treat the product so as to yield a marketable commodity?

Few farmers consider the beet as growing a leaf, which, properly dried, is an excellent food for cattle, and until a few years ago, the content of sugar in the beet was unknown, yet today thousands of acres of beets of a sugar content of from 12 to 20 per cent are grown, and beet sugar is as popular as that of cane.

Potatoes may be cleansed, dried, peeled, cut into cubes and dried again, a feasible method of overcoming waste.

Fruits and grapes that are solid, and showing no

trace of decay, are carefully packed and shipped to other markets; but is it fair to nature that the bruised fruit should be permitted to waste? Apple cider or grape juice finds a ready market and returns a reasonable profit on the investment necessary for the electrically operated press.

Fruits may be cured and a delicious flavor retained where easily regulated electrical heating elements are installed.

Again, all fruits are rich in sugar, containing from 5 to 30 per cent, a by-product, if you wish, readily obtained from fruit which may not be selected for shipment. Through the use of electrically operated apparatus, even a fair profit accrues to the farmer by the sale of his grapes, in order that the sugar content

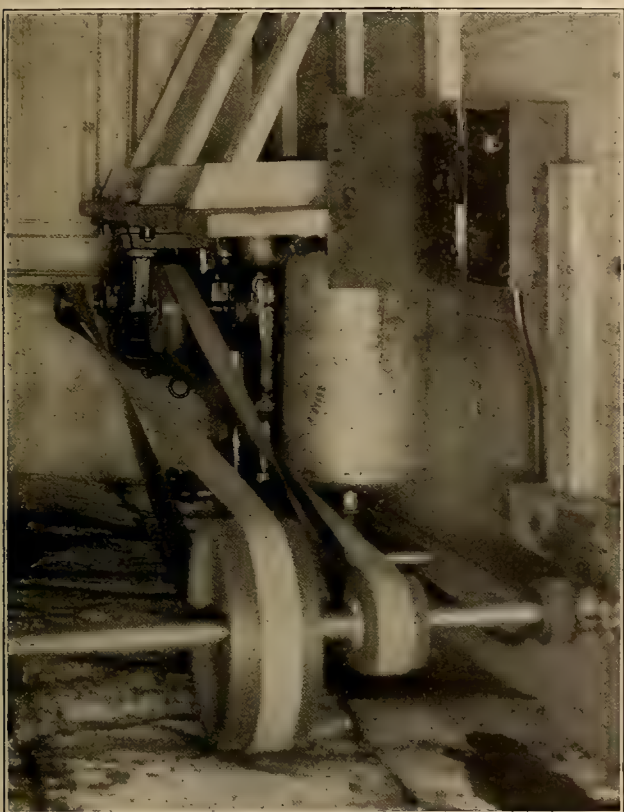


Fig. 2. Electrically Operated Milking Machine.

may be utilized instead of permitting the fruit to dry on the vine and waste, possibly due to the sluggish market for wine and alcoholic by-products. Even when the juices are extracted, the pumace, often wasted, is valuable as a fertilizer for the soil.

Many vegetables grown in large quantities and resulting in an over production may on analysis yield to a mechanical process, which returns in other forms a profit greatly in excess of that contemplated when the seed was placed in the soil.

Consider again, if you will, the potato, even the leaves of which vegetable, when dried, are an excellent food for cattle destined for the market, by reason of the fattening qualities possessed by the dried leaf.

Conservation of our resources has heretofore related only to our natural supplies, such as timber and mineral wealth, yet may it not be of equal or more importance that investigation be made with a view of utilizing for foodstuffs the vegetable and its leaf, distilled products or utilizing it for food instead of applying the torch? Agriculture is not the robbing of the soil of her best, but in applying scientific principles, which convert even the worst growth to a marketable by-product. To accomplish results, of this character, electrically operated apparatus is necessary that the cost per unit of by-product be such as to allow a good margin of profit. Descriptions of apparatus for farm purposes might continue as long as human intelligence and ingenuity constantly strive to provide the farmer with applianaces with which to reduce to a minimum of expense the labor, at one time necessary, to produce his crop, and how to utilize the surplus in by-products, or conserve it for future use.

A PRIMARY STANDARD OF LIGHT.

BY LEONARD HIRSHBERG.[1]

A true standard of light must offer units of length, duration, and mass, which no present standard does. Burner dimensions and fuel consumption or composition, used in many so-called standards, are by no means fundamental measurements. A real primary standard is such a quantity as is actually used in the luminous flux, with a unit called the lumen. Luminous flux, is flux of radiant energy of a certain quality, in virtue of which it is useful for illumination; the energy possessing, in short, the capacity to arouse through the eye the sensation of light. There are naturally two sides to such a luminous flux, to wit: the external or physical source of light, and the human, internal, or psychological interpretation of the source. The rate of flowing, radiant external energy is expressible in physical units, while the unit of the sensation of light, the psychological portion that determines the efficiency of that physical source, must be the coefficient.

Hence there must be an energy unit of light flux in agreement with a given unit of sensation. One watt of radiation of a maximum luminous efficiency as the unit of the source is proposed and it is suggested that this be determined by measuring both light and radiation with a selected monochrome radiation of known efficiency. The mercury green line (.546 m) lying close to the maximum of visual sensibility was thought suitable.

In order to make any such suggestion of use, it is necessary to establish a relative efficiency for various radiations, to determine the luminosity of the average eye for the normal spectrum. To do this it is necessary to have a method which shall make possible the measurement of lights of different color. This was until recently impossible.

The determination of the relative brightness of different colored lights has always been a difficult and unsatisfactory process. Various methods such as visual acuity, persistance of vision, equality of brightness, and flicker, have been employed in the attempt to evaluate the different qualities of radiation on the basis of their common attribute of brightness. Even such psychic factors as change of color with decreasing illumination—the socalled Purkinje phenomenon—has been tried.

The radiations from a source of light must be measured according to their value as light producers

[1] A. B., M. A., M. D. (Johns Hopkins).

in terms of the radiation of maximum light-producing power. The ratio of the sum of these to the whole gives the efficiency of the radiation expressed as a percentage of what it will be were all the radiation of maximum light-producing power.

This efficiency is exactly parallel with lumens per watt. It is in fact, the ratio of the lumens per watt of the radiation from the light source compared to the maximum possible ones. It is necessary to know only the maximum possible luminous output in order to determine the luminous efficiency.

The absolute value of the unit of flux may in general be found by measuring both in light and energy units, a radiation of known luminosity. The problem of determining the mechanical equivalent of light now becomes identified with the establishment of the primary standard, since this is specified by the least mechanical equivalent. Finally, then, Mr. Ives of the National Lamp Association of Cleveland, Ohio, now brings forward in addition to his contributions last year in the Philosophical Review, the proposition that the unit of luminous flux be defined as the flux from a source which radiates energy of maximum luminous efficiency at the rate of one watt. The method of estimating luminous efficiency, and the method of colored-light photometry which it is necessary to adopt before a primary standard of light can be established, is now presented for the first time.

LIGHTNING PROTECTION OF TRANSMISSION LINES

BY ALFRED STILL.
Member A. I. E. E., Inst. E. E.

Methods of Relieving Conductors of High Potentials Before Damage Is Done to Insulators or Machines and Apparatus Connected to the Line.

Water jet arresters.—By directing a stream of water from the nozzle of a grounded metal pipe on to the high tension conductors, a high resistance non-inductive path to ground is provided for the extra-high potential charges on the line; but there will be very little leakage of power current. Arresters constructed on this principle have been found useful in practice; but the employment of jets of water has its objections. It is usual to put the jets in action only at times when electric storms are pending; and the reliance on the "human element" renders the apparatus less valuable than an equally effective device which is always ready to act. Patents have been granted for various forms of water jet arresters, but they are not extensively used at the present time. The chief function of the water jet is to prevent the building up of static pressures on the line.

Spark gaps.—Nearly all lightning arresters are designed on the principle of one or more spark gaps between the conductors and ground, the air space being so adjusted that the normal difference of potential between the line and ground is insufficient to jump the gap; but abnormally high pressures will break down the insulation of the gap, and so find a path to ground before the pressure is sufficiently high to damage the insulation of the line or the apparatus connected thereto.

Horn gap.—The ordinary horn gap arrester of the type shown in Fig. 3, is so well known it requires no detailed description. When the potential rises to such a value that it can jump the gap at the base of the curved wires, the power arc will follow the discharge; but, owing partly to the upward tendency of the heated air, and mainly to the magnetic field produced by the current itself, the arc is driven upward toward the ends of the "horns" where, after being sufficiently drawn out in length, it is finally ruptured. The horn gap is not effective when set to discharge at pressures below 13,000 volts, because, with a small gap (less than 1 in.), the arc may not rise and break properly. The usual settings for horn gaps are as follows; the

Fig. 3. Typical Horn Gap Arrester.

figures referred to as "voltage" being the approximate breaking down potentials:

Voltage.	Gap.
25,000	1½ in.
50,000	2½ in.
75,000	4½ in.
100,000	7½ in.

A non-inductive resistance should be connected in the ground wire from the horn arrester. An ordinary wooden barrel filled with water, with a connecting plate at the bottom, and the upper terminal carried about 6 in. below the surface of the water, makes an effective resistance. If no resistance is provided in the ground connection, the momentary discharge of the power current may be excessive, and there is the possibility of synchronous machines being thrown out of step.

One serious disadvantage to the ordinary horn gap arrester is the liability of an intermittent arc setting up surges and high potential disturbances which may lead to more trouble than the original cause of

the spark-over. Fairly satisfactory results have been obtained by providing a number of horn gaps on a high tension transmission and "grading" these, by adjusting some of them to discharge with a very small rise of pressure through a high resistance; while other sets would have larger gaps and lower resistances in series; the very largest gap being such as to break down only rarely, under exceptionally high pressures, and this should have a very low resistance in series, but may with advantage be protected by a fuse.

Horn arresters, if intelligently placed and properly connected and adjusted, are capable of affording good protection; but the multi-gap and "low equivalent" arresters, as originally suggested by Mr. P. H. Thomas, have some special features which have led to their frequent adoption on a.c. circuits for pressures up to about 40,000 volts.

Multiple-Gap Low Equivalent Arrester.

In this type of arrester there are many air gaps in series between the line and ground. No single gap is greater than 1/32 in. or 1/16 in. and it occurs between the adjacent surfaces of small cylinders made of

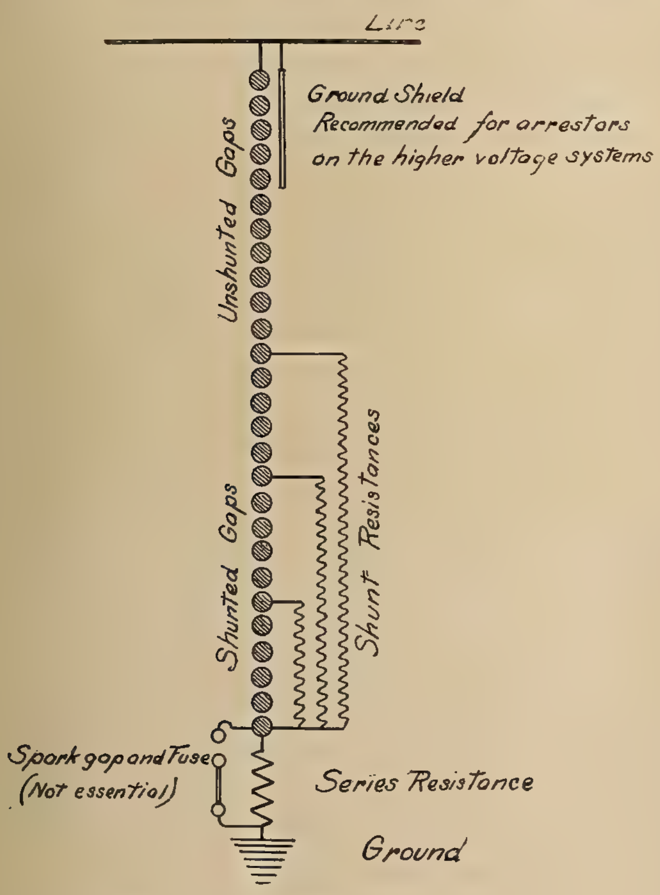


Fig. 4. Multiple Gap Type of Arrester.

a so-called "non-arcing" metal as used in the earlier types of Wurts arrester. The number of gaps in series depends upon the working voltage of the line, and the last of the metal cylinders is connected to ground (or to one of the return conductors, as the case may be) through a non-inductive resistance, which may, with advantage, be shunted by a fuse in series with a spark gap. Sometimes a portion of this resistance is bridged by a number of spark gaps, all as shown in the diagram Fig. 4. These shunted gaps act as a sort of by-pass for heavy discharges, the amount of the unshunted resistance, through which all discharges have to pass, being comparatively small. The theory of the low equivalent arrester has been ably discussed by other writers.[1] Its action is, briefly, as follows. There is a certain electrostatic capacity between consecutive cylinders, and between each one of these cylinders and ground; and the potential gradient is considerably steeper at the high voltage end of the arrester, with the result that, when the total voltage across the arrester reaches a certain critical value, the break-down occurs between the first and second cylinders. The second cylinder is then connected to the first by an arc, so that its potential rises accordingly, until a break-down occurs between the second and third cylinders; and so on. The line current then follows the discharge, and in so doing, tends to produce a uniform fall of potential along the line of cylinders, with the result that the maximum potential difference between cylinders is considerably less than that required for the initial break-down, and the power arc is ruptured. When a break-down occurs between two cylinders, the potential of the lower cylinder of the series will depend upon the quantity of electricity which passes to it from the more highly charged cylinder. The initial current is really a capacity current, and it will therefore be greater at the higher frequencies; but, by a scientific proportioning of the shunted resistance, a very satisfactory arrester of this type can be made, for use on circuits up to about 13,000 volts: it is less effective on higher voltages, but is actually used on 20,000 volt, and even 35,000 volt transmission lines.

The multiple gap arrester is essentially adapted for dealing with line oscillations; but a heavy high frequency discharge will generally jump a straight gap over insulation several times greater than the equivalent insulation of the arrester; and, for these reasons, a judicious combination of the horn gap and multiple gap arresters is to be recommended.

One reason why the multiple-gap low equivalent arrester is not satisfactory on very high voltage systems is that the necessary increase in the number of gaps to prevent arcing over by the line voltage alone is out of all proportion to the increase in voltage. There is also much uncertainty as to the number of gaps required, as this seems to depend on the position of the arrester relatively to surrounding grounded objects. With the ground potential brought very near to the arrester, the potential gradient at the end near the line frequently becomes high enough to ionize the air between the cylinders, thus carrying the line potential to lower cylinders, until the remaining gaps are so few that a discharge occurs. In order to obtain the more equal division of the total potential difference, and so allow of a reduction in the total number of gaps, such as would be obtained by removing the whole arrester to a considerable distance from grounded objects, a metal guard plate or shield is sometimes placed near the gaps at the high potential end of the arrester, and connected to the line wire as indicated in Fig. 4.

(To be continued.)

[1]See Dr. Steinmetz on the theory of this type of arrester in Vol. XXV (1906) of the Proceedings of the A. I. E. E.

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POWER AND GAS

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FOUNDED 1887 AS THE
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CONTENTS

The New Year

This is the season of New Year's resolutions—a time as described by the old German professor, "to vipe id all oud." The editors of the Journal at this time would wipe out of their consciousness any ambitions they may have for its future which ring not of the highest and sincerest tone. They desire to take advantage of this opportunity to thank its readers and friends for the hearty, whole-souled support given them during the past year. The year just completed finds our standards raised much higher toward our ideals and a financial and moral support hitherto unexperienced.

The Journal has high ideals of accomplishment for the immediate future. Subjects of timely interest, discussed in its columns, which have proved of such widespread comment during the past year, will be continued with new and enlarged vision.

"Electrical Pumping and Irrigation," which is now being followed by our readers throughout the great irrigable districts in the West, will be continued, and the Journal will endeavor to maintain its unique position among technical publications in discussing this all-important present adjunct to hydroelectric salesmanship.

The timely discussions on "Readiness to Serve Methods" applied to agriculture will also be continued. The data which is each week being collected by Mr. Mateer, agricultural sales manager of the Great Western Power Company, in the great Sacramento Basin of California, is proving of value to other sales campaigners of the West, looking toward agricultural power possibilities.

In early issues of the year, the Journal will begin a series of articles on the Diesel engine and its possibilities for Western application. The theory of this remarkable engine will be gone into and the reader lead by simple direct steps to grasp the fundamental, efficient thermodynamic principle upon which it operates.

Auxiliary steam plants, which have become the steadying factor of Western hydroelectric practice, will also be treated in our columns by an authority on elements of design. Wrinkles in wiring and conduit laying in large Western cities will be treated by one now in the midst of this work. Our readers will gain many new ideas of methods employed and technical principles involved.

To form a climax of our endeavors for the new year, an epitome of great engineering achievements, which make the West stand forth as world-beaters, is being prepared largely by many of those who have personally mastered these great triumphs. These articles, forming in the aggregate a harmonious whole, will appear from time to time during the year.

Soliciting, then, the hearty co-operation of all in our earnest efforts, we desire to wish one and all the happiest and best New Year ever before experienced.

Electricity in the Dairy

Some months back when mechanically operated milkers first came upon the market, the great manufacturers of milk products of the West advised their farmer clients not to use them, due to the injury such apparatus seem to bring upon the teats of the cow after continued applications. Those, however, who have seen the new application for electrical energy in the way of the vacuum process of milking, an illustration of which is shown elsewhere in this issue, cannot help but marvel, as the dentist would say, "at this apparently painless extraction."

Few who have enjoyed early boyhood days on the farm can keep from rcalling with a shudder the early morning hour with the cow. The cold fingers, the cramped position—all roll by in memory's vision. Today, however, the farmer seems to be getting every modern refinement and nicety in invention—all of which makes a happy smile loom over the face of the agricultural power salesman.

A New Year's Suggestion

Thanksgiving is past, Christmas has come and gone, the New Year is upon us. Let us be thankful for things accomplished and at the same time purpose to make a better, cleaner log-sheet for the coming season's run.

The outward personal attitude with which we attire ourselves in our daily work has indeed much to do with actual results attained. This attitude, though unexpressed in words, yet reflected from the countenance of either employer or employee in the modern utility company, speaks its silent message in an "eye-language" not only distasteful and depressing to all observers, but it actually brings about inefficiency in results accomplished.

In the building of a great transcontinental railroad wherein are often employed laborers of the lowest type, morally and mentally, perhaps the rule by the club may at times prove the more effective. Perhaps the display of three armies of laborers—one coming, one going, and one actually on the job—often overpowers the "bohunk" laborer by arousing within his inner make-up all the pangs of fear inbred in his nature and handed down to him as a precious heritage from days of savage splendor. In the modern highly scientific and keenly developed mind of the utility employe, however, the rule by club has no place. Nor is there any room upon the employer's countenance for an attitude of nonchalance.

The cry of the day is service—maximum service at minimum cost. The keynote of service is loyalty—a loyalty that makes employer and employe stand or fall together in the operation of a public utility.

The question is often asked, how may loyalty be best induced in a great public utility? Many have presumed to answer this question—few have actually solved the riddle. Needless to say, the first and foremost step is to wipe from the countenance that certain attitude. As soon as this is accomplished, and an approachable outlook begins to emanate from the chief's down through the sub-chief's offices, it is wonderful how quickly this subtle quality, "loyalty," is engendered. Inded, loyalty is the vital fluid generated by the establishment of a sympathetic field of force between employer and employe, more subtle and yet more powerful than the force lines emanating from the dynamo. Loyalty, too, is more delicate than the violet, and this sprinkling of a sympathetic relationship from employer to employe meets the instant response seen when upon the withered violet water is gently sprayed.

If now you ask what this state of mind is, what the three small word adjective is by the removal of which such wonders may be wrought, we appeal to you to forever remove from your countenance, if ever it were there, and cast into the bottomless pit that "Go-to-h——" attitude.

Interurban Aids in Oregon

As our leading article of this issue is devoted to an extensive description of the interesting network comprising the holdings of the Portland Railway, Light & Power Company, the subject of interurban aids in the upbuilding of the West is certainly not amiss. An analysis of the last national census of both Eastern and Western cities truly indicates that city and rural growth has followed always the bold leadership of the pioneers in interurban electric line construction. Cleveland, Detroit and Indianapolis are striking Eastern examples, while Spokane in the Northwest and Los Angeles in the Southwest have proven themselves emphatic Western examples of the stimulating effect of such far-sighted generalship.

During the past six months, Portland and, indeed, almost every nook and hamlet in Western Oregon, has been interlinked with electric lines. Portland will thus unquestionably arise in the near future as a possible supreme leader in Western enterprise and growth. The beauty of electrification is, however, that big city centers are not alone encouraged. This blessing of interurban electric railways, like Portia's dream of mercy, "is not strained; it blesseth him who gives and him who takes." The rural community and city alike feel its invigorating, "ozonized" life.

The Portland, Eugene & Eastern alone is preparing to operate over 340 miles of track, and, when thus completed, there will be nearly 700 miles of electric interurban tributary to Portland. Oregon as a State may well value this new and enterprising work as one of her most substantial assets.

It is indeed surprising that the great metropolitan district in Central California still lacks interurban electric facilities in keeping with its growth. The Oakland, Antioch & Eastern, soon to be in rail connection with Sacramento, will do much in making a substantial start. Still, the beautiful Santa Clara Valley, the city of San Jose, and countless other prospects but awaiting the magic touch, lie disconnected electrically. The bold, fearless policy displayed in and about Portland, in arising to the possibilities of electrification, is indeed to be commended.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

PERSONALS.

Geo. S. Nickerson, a mining engineer of Eureka, Nevada, is spending a few days in San Francisco.

R. C. Pollard, of the Pa-cific Gas & Electric Company's engineering staff at the Drum Power House, has returned to San Francisco to remain over the winter months.

T. H. Nelmes, formerly of the Great Western Power Company, San Francisco, has become associated with the sales force of the Pacific States Electric Company.

L. E. Sperry of San Francisco, **B. C. Chase** of Los Angeles and **H. G. Behnemann** of Seattle have been appointed selling agents for W. N. Matthews & Brother of St. Louis.

A. E. Wishon, assistant general manager San Joaquin Light & Power Company, who has been on an extended absence from Fresno over the holidays, is again at his desk.

Frank A. Binford, Jr., assistant to W. D'A. Ryan, illuminating engineer for the Panama-Pacific Exposition, left for Schenectady, N. Y., on New Year's day. Mr. Benford expects to be in the East for several months.

W. J. Heger, Jr., formerly hydraulic engineer with F. Numa of Oakland, Cal., having just returned from an Eastern tour of inspection, has opened offices in the Rialto building. San Francisco, to handle irrigation pumping plant installations as a specialty.

Ralph S. Phelps, Pacific Coast manager of the Safety Insulated Wire and Cable Company, expects to leave within the next week or ten days for the East. **Herbert Smith**, his assistant, will accompany him, and about the first of February will bring an Eastern bride to California.

J. A. Vandegrift has been elected the first president of the newly organized Electrical Development League of Alameda County. It is proposed that the new organization pursue similar lines of development work in Alameda County as the Electrical Development League of San Francisco.

C. H. Gaunt, formerly general superintendent of the Western Union Telegraph Company, has been promoted to the position of general manager of the Pacific Division of that company with headquarters in San Francisco, while H. F. Dodge becomes assistant general manager, with headquarters in the same city.

F. L. Hutchinson, secretary of the American Institute of Electrical Engineers, has notified **Charles C. Moore**, president of the Panama-Pacific International Exposition, of the formal acceptance of the invitation to hold the meetings of the International Electrotechnical Commission and the American Institute of Electrical Engineers at San Francisco in 1915.

B. S. Josselyn, president of the Portland Railway, Light & Power Company, was presented with a scroll containing the signatures of 1000 employes, testifying to their appreciation of his efforts in their behalf during the closing year. A committee, headed by Franklin T. Griffith, delivered the gift. Mr. Josselyn responded to the address of presentation in a feeling manner.

Louis R. Glavis resigned as secretary of the California conservation and water commissions this week. It is proposed to increase the water commission to five members, the governor and state engineer, ex-officio, and three appointive at $25 per diem, with a minimum of $5000 annually. The new law also proposes forty years as the term of license for the use of water for power purposes.

Walter Cook, New York, has been re-elected president of the American Institute of Architects; **R. C. Sturges**, Boston, first vice-president; **F. C. Baldwin**, Fredericksburg, Va., second vice-president, and **Glenn Brown**, Washington, D. C., secretary-treasurer; **B. L. Fenner, C. G. La Farge, H. Van Buren Magonigle**, all of New York, were elected directors for the three-year term, and **Robert Stead**, Washington, D. C., auditor.

LETTERS TO THE EDITOR ON EXPOSITION WIRING.

The following letter, which is self-explanatory, was received by the editors of this journal. The editors are also in receipt of another letter from the exposition authorities which is also of timely interest to all concerned, and which appears below:

San Francisco, Cal., Dec. 18, 1912.

Dear Sir: The specifications for the Machinery Building for the Panama-Pacific Exposition are now in the hands of the general contractors and I notice that the exposition company has cut all the electrical work out and propose to install this work themselves by day labor.

While I have no doubt that they may have a good reason for taking this course, still it is not apparent on the surface and it is just to the electrical contractors in this city that the reason should be given.

Several of the contracting firms have been put to heavy expense retaining on their staff high grade employees, which the conditions of the business, during the last two or three years, have not warranted and they have incurred this expense anticipating that the exposition work would require a large force of men competent to carry out this work with promptitude and success; while now it appears that if this program is carried out the electrical contractors will receive no benefit whatever from the business induced by the fair.

I feel satisfied that the Exposition Company can contract much of their work cheaper than they can do it themselves by day labor.

Yours, etc.,
A. E. BROOKE RIDLEY,
Electrical Engineer and Contractor.

San Francisco, Cal., Dec. 26, 1912.

Dear Sir: Replying to your letter of the 23d inst. and the letter from Mr. A. E. Brooke Ridley, which I return herewith, I beg to inform you that the reason the electrical work was not included in the specifications recently issued for the Machinery Building, was that the plans for wiring depend upon such factors as the exterior and interior lighting and power distribution, concerning which full data was not available at the time the building specifications were written.

Before the building is advanced to the stage where wiring could be done to advantage, it is planned to issue plans and specifications and request bids for the electrical work involved.

Submitting the foregoing for your information I remain,
Yours very truly,
G. S. BAYLEY.
Chief M. E. and E. E., Panama- Pacific International Exposition Company.

TRADE NOTES.

The Johns-Manville Company are now occupying offices and lofts in their new building on the northwest corner of Second and Howard streets, San Francisco.

The Cincinnati office of the Fort Wayne Electric Works, which has been at No. 1125 Union Trust Building, has been moved to Nos. 704-5, Provident Bank Building, on account of the Gibson House fire. This fire practically destroyed the Union Trust Building, and made a change on the part of the company absolutely necessary. The company is planning to maintain an energetic sales campaign in the immediate future.

COMMUNICATION FROM THE UNDERWRITERS' EQUITABLE RATING BUREAU.

There seems to be a general misunderstanding regarding the Refillable Type of Cartridge and Enclosed Plug Fuses. The Underwriters' Laboratories, Inc., have never approved any type of refillable fuse and offer the following criticism on this type (Underwriters' Laboratories Card No. 3274 dated September 20, 1911; name of submitter, A. F. Daum Company, 504 Diamond street, Pittsburg, Pa.): "Refillable Fuse Casings, 250 and 600 volts, all capacities. Fibre tubes threaded for metal cap terminals. Designed to be used with renewable fuse wires clamped at ends of casings between washers and the threaded caps and filled with shredded asbestos packing." Report July, 1911: "Examination and tests of samples of Daum fuse casings indicate that, while a certain degree of protection may be secured by them when used with fuse elements suitable to the circuits of which they are a part, their construction is not such as to insure proper assembly and use under all conditions of service. The ease with which fuse elements of unduly large size or of wholly unsuitable material may be used in them without external evidence of such misuse is judged a serious defect. Under conditions liable to be met in practice, these casings are not considered to be the equivalent of standard cartridge enclosed fuses or of properly rated open link fuse, suitably enclosed in fireproof cabinets either in respect to the protection they afford to electric circuits or in freedom from hazards incident to their operation." The other fuses of this type, which have been submitted to the Underwriters' Laboratories, Inc., and have been criticised are the following:

Herman Olcovich & Son, 625 Market street, San Francisco, Cal., and Geo. R. Willet, Pittsburg, Pa.

In addition to the manufacturers who have submitted this type of fuse to the Underwriters' Laboratories, Inc., for their approval, there are quite a number of manufacturers who also make this type of fuse and sell same.

Many times manufacturers of unapproved fuses, advertise their products in a way to mislead the public. For instance the following wording has been used in their advertisements: "In presenting this catalogue to the electrical industry, we wish to announce a Renewal Cartridge Fuse, which to the best of our knowledge, is the first device of its kind designed and constructed to meet the specifications of the National Board of Fire Underwriters, whose rulings govern the use of a device of this nature."

Therefore, we beg to call to your attention that this Bureau sanctions only the use of fuses, which bear the proper Underwriters' label. A list of approved manufacturers can be found on pages 28 to 31, inclusive, April, 1912, List of Electrical Fittings.

UNDERWRITERS' EQUITABLE RATING BUREAU,
F. D. Weber, Electrical Inspector, Portland.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Dec. 23.

The Escondido Light & Power Company applied for authority to issue and sell at par 49,500 shares of stock, the proceeds to be used in the construction of an electric light plant.

The Palo Alto Gas Company filed an answer to the city of Palo Alto, denying that the rate for gas in the sum of $1.50 for 1000 cubic feet, is unjust or unreasonable.

The Los Angeles Railway Company filed its answer to the complaint of the city of Inglewood, denying charges of unjust rates in its suburban service in Los Angeles county.

The Coalinga Water & Electric Company applied for a certificate of public convenience and necessity to operate in San Luis Obispo, Monterey and Santa Barbara counties.

The Great Western Power Company and the town of Suisun applied for an order directing that the power company be permitted to use the poles of the Pacific Gas & Electric Company and the Pacific Telephone & Telegraph Company in the town of Suisun, for the purpose of stringing its wires.

Dec. 24.

The San Dimas Water Company filed application for the purchase of the San Dimas Irrigation Company, the Artesian Belt Water Company and the Charter Oak Reservoir Company, and asked for authority to issue 2000 shares of capital stock of the par value of $100 each, and to sell $100,000 of bonds.

The Stockton Terminal & Eastern Railroad Company applied for authority to issue $378,000 of bonds, to be used in extending its line running out from Stockton.

The Palermo Land & Water Company applied for permission to make increases in the charges for water.

Dec. 26.

The Terra Bella City Water Company, of Terra Bella, Tulare County, applied for permission to purchase a water plant from the Terra Bella Development Company.

Dec. 27.

The city of Santa Paula filed a complaint against the Santa Clara Water & Irrigating Company and against the Interurban Land Company, alleging that the open ditches in Santa Paula were unhealthful and a public nuisance. The complainant asked that the irrigation companies be compelled to substitute submerged pipes.

SAN FRANCISCO ELECTRICAL DEVELOPMENT LEAGUE.

Mr. T. E. Bibbins, who was elected president at the December meeting of the Electrical Development League, announces the following as the personnel of the various committees to serve during the ensuing term:

Entertainment Committee.
J. G. De Remer
Stanley Walton
G. I. Kinney

Membership Committee.
W. L. Goodwin
W. Brewster Hall
S. P. Russell

Ways and Means Committee.
H. V. Carter
W. S. Berry
E. B. Strong

Finance Committee.
C. E. Wiggin
W. W. Hanscom
Lee H. Newbert

Goodfellowship Committee.
J. A. Vandegrift
A. E. Drendell
F. J. Cram

Grievance Committee.
P. Decker
Garnett Young
G. C. Holberton

Publicity Committee.
A. H. Halloran
J. W. Redpath
Guy L. Bayley

The next meeting of the League will be held at the usual meeting place Tuesday, January 14. Let all attend and start off the League's first meeting of the new year with a rousing attendance.

INDUSTRIAL

WESTINGHOUSE ELECTRIC LOCOMOTIVES IN THE WEST.

A 50-ton standard-gauge Baldwin-Westinghouse electric locomotive, suitable for yard service, has recently been furnished the Spokane & Inland Empire Railroad Company for use in Spokane.

Four Westinghouse No. 301-D-2 motors, geared with a ratio of 17:60 to 37¼-inch wheels and Westinghouse HL electro-pneumatic control are used. A double and E. L. type automatic brake equipment is employed, and air for the braking and control systems supplied by two D-3 motor-driven compressors, each having a displacement capacity of approximately 35 cubic feet of free air per minute. A hand brake is provided for holding the engine when it is stored up in yards.

The locomotive is designed to traverse curves of 34 feet radius when running without a trailing load, and the longitudinal frame sills are four in number, consisting of 12-inch channels. Strong diagonal bracing, consisting of 1½ x 6-inch bar iron, is used on each side of the frame between the middle and outside channels. The cab is of steel, and centrally located. It has a length of 12 ft., and a width of 9 ft. 3 in., and may be entered from either end. Controlling equipment is installed in duplicate, the locomotive being arranged for double-end operation.

A 50-ton Baldwin-Westinghouse Electric Locomotive for the Inland Empire System, Spokane, Washington.

One air compressor is mounted under one of the hoods of the cab, and under the other hood of the cab is mounted a second air compressor and blower. This motor-driven blower supplies air for ventilating the traction motors. The motors and auxiliary apparatus have sufficient capacity to enable the locomotive to exert continuously a tractive effort of 9400 pounds with 600 volts at the motors, with average wheel diameter of 36 inches. It will also exert a tractive effort of 16,000 pounds at approximately 9.2 miles per hour with 600 volts at the motors. With clear, dry rails it will be able to exert momentarily a maximum tractive effort of 25,000 pounds.

ANOTHER PHASE OF THE TELEPHONE'S VERSATILITY.

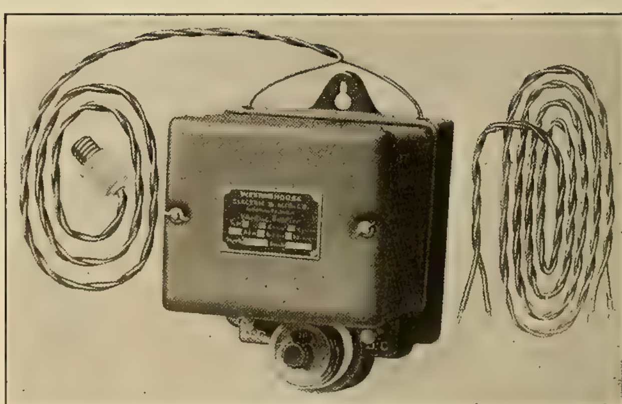
The entertainment which was presented by the New York Telephone Society and participated in by members of the American Telephone, New York Telephone and Western Electric Companies was a satirical musical hodge-podge entitled "Examinations," a travesty of an examining board inviting applications for positions at the telephone business. The part of the Western Electric Company was portrayed by W. D. Lindsey, of their advertising department, who was assisted by a wooden dummy designated as "The Very Latest Product of the Factory."

The dummy not only talked well but moved his arms, head and jaws in such a manner that the act seemed to be a perfect marvel of ventriloquism. What no one suspected, however, was the fact that concealed ingeniously in the body of the dummy was a Western Electric "loud speaking telephone" which was connected to a transmitter behind the scenes by means of wires running down the feet of the chair to contact sockets on the floor of the stage. The telephone end of the "ventriloquial" conversation was conducted by P. M. Rainey, the designer of the dummy, and a further feature of the act was the rendering of songs by means of a phonographic attachment.

This very unusual use for a telephone instrument is but another illustration of the remarkable commercial versatility of the new loud speaking telephones which have already proven their worth as announcers in railroad terminals, baseball parks and exhibition halls. There are, and probably will be found, many more fields of activity, for these remarkable products of the telephone engineer's art, both in and out of the theatre.

TYPE G VIBRATING RECTIFIER FOR CHARGING THREE-CELL BATTERIES.

The apparatus consists essentially of a polarized relay acted upon by two alternating current magnets so that it vibrates in synchronism with the alternations of the current, and arranged to reverse the connection of the circuit as the current reverses. The vibrating arm is magnetized by current from the direct-current side, so that one end is pemanently north and the other end permanently south, depending on the way the battery is connected.



Improved Vibrating Rectifier.

The rectifier can be operated on any 60 cycle alternating current circuit of 100 to 120 volts, and will charge three cells at a rate of 6 to 8 amperes.

To charge a battery all that is required is to connect the attachment plug to a lamp socket and the lower binding posts to the battery. No care need be taken as to which pole of the battery is connected to which binding post, as it is immaterial. Should the supply circuit be interrupted temporarily the rectifier will start again as soon as power is restored to the line.

NEWS NOTES

INCORPORATIONS.

ESCONDIDO, CAL.—The Escondido Light & Power Company; $50,000, subscribed $500, by G. V. Thomas, E. G. Logan, W. W. Prior, M. Conway and C. S. Palmeter.

ROSEBURG, ORE.—Articles of incorporation have been filed for the Umpqua Power, Light & Ice Company. The capital stock of the corporation is placed at $25,000, $17,500 of which is common stock. The incorporators are James Christian Alexander, Attorney J. A. Buchanan and Attorney O. H. Porter. The main office of the company will be maintained in Roseburg. The purpose is to manufacture and sell ice, water, light and power and to engage in a general refrigerating business.

ILLUMINATION.

LOS ANGELES, CAL.—The board of supervisors have sold a county gas and electric franchise to the Los Angeles Gas & Electric Corporation at the rate of $10 per mile.

ELSINORE, CAL.—The Southern Sierras Power Company has applied for a franchise for transmitting electricity in all public streets. The franchise will be sold to the highest bidder on February 10th.

ALBANY, ORE.—Mayor P. D. Gilbert will recommend in his message to the new city council at the first meeting in January that the city install a municipal lighting plant for the maintenance of a cluster light system.

LOS ANGELES, CAL.—The Escondido Light & Power Company has filed an application asking permission to issue and sell at par 49,500 shares of its capital stock, the proceeds to be used for construction of a new electric light plant.

REDWOOD CITY, CAL.—The Halfmoon Bay Light & Power Company has petitioned the board for a franchise to extend the company's lines southward from Halfmoon Bay to the southern boundary of the county. The franchise will be offered for sale on January 20th.

TACOMA, WASH.—The Buckley council has granted a franchise to P. H. Hebb of Tacoma for power purposes, the franchise to run 50 years. Under the arrangement Mr. Hebb agrees to furnish Buckley with power for lighting purposes at less than one-half the rate now being paid.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has just completed the installation of a new 5000 kilowatt turbine, which cost about $100,000, and plan more work for the gas department, which will include a new garage for the company's machines, a gas compressor to serve high pressure lines, two new oil generators, one water gas generator, a lamp black filter, and the construction of new 12-inch high pressure mains from East San Diego to La Mesa.

SACRAMENTO, CAL.—The bids submitted to the city commission by the Great Western Power Company and the Pacific Gas & Electric Company to furnish the city with electrical energy for the next year means a saving of approximately $7500 to the municipality for the next 12 months. The bid of the Pacific company was $5.50 per month per street lamp, which is 50c lower than any record of the city. No bid was submitted by the Great Western. For fire houses and all other public buildings the Great Western was the lowest bidder, the bid being 2¾c per kw.-hr. as against the 3c bid by the Pacific company. The Pacific company was lowest for the electroliers. The same company was also lowest on nearly all motor-power in various public buildings, including the city hall. The city paid the Pacific company during the present year a rate of $6 per street lamp per month. In 1907 the rate was $7.

TRANSMISSION.

PORTLAND, ORE.—The Pacific Power & Light Company announces that it will undertake construction immediately of a power plant at Hood River which will generate 7000 horsepower energy and which will be offered to industrial concerns throughout the valley.

QUINCY, CAL.—The supervisors of this county will on January 9 open bids for the sale of a franchise that has been asked for by the Oro Electric Corporation for the construcstruction of pole and tower lines and the construction of pole and tower lines and the distribution of electricity in Plumas county. Work on the construction of the power line must be commenced in good faith within four months after granting of the franchise and the purchaser must pay to the county five per cent of its earnings after the first five years.

PORTLAND, ORE.—After several weeks of negotiation the Northwestern Electric Company has completed a deal whereby it purchases for approximately $100,000 an acre and a half of ground in Albina to be used as a site for an immense auxiliary steam plant for the generation of electricity. The site was selected after officials of the Northwestern had spent more than two months in looking over the city, and is regarded as an ideal location for the auxiliary generating plant and storage grounds.

FRESNO, CAL.—Electric power for San Miguel and Paso Robles has been turned on by the San Joaquin Light & Power Company. The new lines, which connect the valley and the coast have been completed for some time as far as Paso Robles. Workmen are still engaged in building the power line and it will be carried into San Luis Obispo. Almost two-thirds of the territory has already been covered and the wiring will be done in a shome time. When the lines are completed and the power is turned on almost all of the territory above Santa Barbara will be receiving its electric power from Crane Valley. Power for this section of the San Joaquin Valley is derived from the same source.

RENO, NEV.—The Nevada Valley Power Company, having a power site on the Truckee River at the Largamarsino bridge, and having other power sites in the mountains near Reno, has filed a $3,000,000 trust deed with the county recorder here, intending to bond its property for this amount to secure money to build its power plants. It intends to run in competition with the Truckee River General Electric Company. The company, in addition to its power sites, owns land and a number of rights of way. The trustee for this company is the International Trust Company of Denver. The directors are: H. D. Danforth, a local attorney; Edison Adams, Edward Bowes, Milton Hamilton and A. F. Tarley, all of Oakland.

BAKERSFIELD, CAL.—Charles K. Badger, who is in charge of the Southern Sierras Power Company's work at Randsburg, declares that the current will be turned on at Randsburg about the first of the year. The Southern Sierras line is nearly complete and its horsepower is received from Inyo county water power. A line 238 miles in length with eight steel towers to the mile has been built from Inyo county to San Bernardino. The Indian Wells Valley in which live quite a lot of new settlers whose postoffice is Inyokern, the Southern Sierras Company already has sold 1000 h.p. A large amount of horsepower already has been sold to Randsburg parties and mining companies and the opening up of new mines is foreshadowed by the cheapness of the power within reach. The Sierras Company will develop 87,000 h.p. at the start and this will eventually be increased to 150,000 h.p.

TRANSPORTATION.

MEDFORD, ORE.—J. A. Westerlund and C. Y. Tengwald have applied for a franchise to operate a trackless trolley system here.

HERMISTON, ORE.—The Hermiston Light & Power Company has been granted a franchise to extend a line to Echo, work to be completed in 90 days. The company will also light Umatilla.

CENTRALIA, WASH.—The Washington Electric Company has applied for a franchise for right-of-way along the county road from the fair grounds to this city for an electric line. Hearing was set for February 21.

LEWISTON, MONT.—From an authentic source comes information that the road being built by the Great Northern Railway from this city to Rockford, N. D., will be electrified. The electrification will cost $10,000,000.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will begin immediately the construction of the extension of the Hawthorne avenue car line from E 60th and Division streets to E. 74th and 29th avenue.

MOLALLA, ORE.—The Portland, Eugene & Eastern Railway Company officially announces the line will be extended to this city. Work will cost approximately $100,000. The proposed line will be changed from Canby to Silverton.

VANCOUVER, WASH.—The Northwestern Electric Company has petitioned the city council for a franchise to operate a street car and light and power system in this city. The matter was laid over until next meeting so that several amendments could be made.

PORTLAND, ORE.—C. E. S. Wood, counsel for the Northwestern Electric Company, is authority for the statement that that concern will build an electric line up White Salmon River and will also operate a steam line up Klickitat. The concern is ready to expend $20,000,000.

NEW WESTMINSTER, B. C.—Plans for the British Columbia Electric Railway Company's proposed yards, which are to be built here at a cost of approximately $200,000, are now before the city council for approval. Work will start as soon as same are passed on.

LEWISTON, IDAHO.—The City Council will soon be asked by F. L. Sturm, of the Lewiston Electric Railway Company for an operating franchise. Work of constructing the line between Lewiston, Clarkston and Asotin will be started within 30 days after the franchise has been granted.

PORTLAND, ORE.—The Electric Engineering Corporation has been awarded the contract for installing a 1000 kw. hydroelectric development plant on Wind River, Wash., to be used for electric logging purposes. The concern named solicits prices on material needed on the project. Further information can be obtained from the Portland office.

PORT ANGELES, WASH.—Two concerns have applied to the city council for a franchise to install and operate a street railway system in this city for a period of 50 years. John H. Dalton, Chicago, et al., were first petitioners, which was followed by request of the Olympia Power Company. Both applications were referred to the city attorney and franchise committee.

MARTINEZ, CAL.—February 1 has been set as the day for the opening of regular passenger traffic over the Oakland and Antioch Railway from Bay Point through the Redwood Canyon tunnel to Oakland. At the present rate of progress, 12 to 15 feet per day, the tunnel will be finished by January 10, and several days will be allowed for the operating of heavily loaded dirt trains through the tunnel to settle the roadbed. The rails have been laid up to the east portal of the tunnel, and the sub-contractors have been offered a handsome bonus if they have their work completed by January 10.

SAN FRANCISCO, CAL.—Preliminary steps for a municipal railway in Van Ness avenue from Market street to the bay to furnish transportation facilities to the Panama-Pacific Exposition and act as a cross town line for the Geary street road, have been taken by the Supervisors. To the public utilities committee was referred a resolution which contains an ordinance setting forth that public necessity demands the construction of a municipal double tracked street railway in the avenue, including switches connecting with the Geary street road. The second section of the proposed ordinance directs the Board of Works to furnish within 20 days plans and estimates for the construction of the road.

LOS ANGELES, CAL.—An important step toward the building of the proposed municipal railroad and the relieving of traffic congestion on Main street was taken when the Public Works Board advertised for bids for the construction of the San Pedro street line between Aliso and Ninth streets. This line, which will be the first link in the proposed municipal road to the harbor, will be a three-rail system, affording opportunity for the operation of both broad gauge cars of the Pacific Electric and narrow gauge cars of the Los Angeles Railway Company. Bids will be opened January 10. It is expected that the only bidder will be the Pacific Electric, which has the equipment ready for the work. As soon after January 10 as possible the actual work of constructing the line will be started.

TELEPHONE AND TELEGRAPH.

BELLINGHAM, WASH.—The Government Forest Service will build a telephone line from a point on Baker Creek to old Mazama cabin on the slope of Mt. Baker. Work will begin in the spring.

RIALTO, CAL.—The Pacific Telephone & Telegraph Company has been granted a franchise to transmit electricity for telephone and telegraph purposes in and upon certain streets and public places according to the terms of the franchise.

CHEHALIS, WASH.—G. F. Allen, forest supervisor, Tacoma, has applied to the Lewis county commissioners, for the right to erect a telephone line along certain county roads near and through the forest reserve in eastern part of the county. January 6 was set for the hearing.

ABERDEEN, WASH.—J. A. Chambers, representing a company recently formed which purposes to build 20 miles of telephone line to circle North River country, announces work will begin the first of the year. Line will be connected with the central station of the Pacific Telephone Company here.

VISALIA, CAL.—At a meeting of Woodlake residents and property owners in Visalia the Woodlake Rural Telephone Company was formed. A committee consisting of E. L. Hughes, J. F. Mitchell and Steve Webb was appointed to investigate the cost of the proposed line.

SAN FRANCISCO, CAL.—Complying with a request from the Pacific Telephone Company, the State Harbor Board at a meeting last week granted permission to that company to install three additional telephone booths in the Ferry building to relieve the congestion at the pay station in the south wing.

PORT ANGELES, CAL.—C. J. Farmer, president and general manager of the Angeles Telephone & Telegraph Company, announces that his company will immediately begin the reconstruction, enlargement and improvement of the local telephone system. A new central station and office building will be erected on Fourth street.

ELLENSBURG, WASH.—C. E. Hickman, district commercial superintendent of the Pacific Telephone & Telegraph Company is authority for the statement that 88 miles of telephone line, costing approximately $75,000, will be strung in 1913. The proposed line will be known as the Lind-Ellensburg cut-off and will afford almost a direct line from Spokane to Seattle. Work will be started the first of the year.

ALPHABETICAL INDEX TO ADVERTISERS

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
Geo.E.DowPumpingEngineCo.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Western Electric Company

Alarms, Fire
Dean Electric Co.
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Cross
Western Electric Company

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Magneto
Western Electric Company

Bells, Electric
Pacific States Electric Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
"Babcock & Wilcox," "Stirling," Moore & Co., Chas. C.
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.
Tracy Engineering Company

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Paraffine Paint Co., The

Burners, Gas Lighting
Western Electric Company

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleaners, Boiler Tube
"Weinland," Moore & Co., Chas. C.

Cleats, Porcelain
General Electric Company
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.
Western Electric Company

Coils, Induction
Kellogg Swbd. & Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & **Mfg.** Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
Geo.E.DowPumpingEngineCo.
"Smith-Vaile," Moore & Co., Chas. C.
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
"Buckeye," Elec. Agen. Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Drendell Electric & Mfg. Co.
Westinghouse Elec. & **Mfg.** Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Cord, Flexible Bell
General Electric Company
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Pierson, Roeding & Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Pierson, Roeding & Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Dynamometers
Sprague Electric Company

Economizers, Fuel
"Green," Moore & Co., Chas. C.

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Tracy Engineering Company
Westinghouse Machine Co.

Engines, Steam
Fairbanks, Morse & Co.
"McIntosh, Seymour," "Fleming," "Ideal," "Hooven, Owen & Rentschler," Moore & Co., Chas. C.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
"Ridgeway," Tracy Eng. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
"Turner,"Moore & Co.,Chas.C.
Westinghouse Elec. & **Mfg.** Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
"White," Elec. Agencies Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.
Century Electric Co., San Francisco, 56 Natoma St.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of Otis & Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Dow Pump'g Engine Co.,Geo.E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.

Economy Electric Co.
San Francisco, 444 Market

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 726 Mission
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heaters and Purifiers, Feed Water
"Reilly," "Goubert," "Stilwell," Moore & Co., Chas. C.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Sprague Electric Works

Hose, Armored
Sprague Electric Works

House Lighting Outfits
"Dayton," Elec. Agen. Co.

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
Electric Agencies Co.
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps, Incandescent
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Lamps, Tantalum
General Electric Company
Pacific States Electric Co.
Western Electric Company

Lamps, Tungsten
Brilliant Electric Co.
General Electric Company
Johns-Manville Co., H. W.
"Star," Kendrick Elec. Co., Jos. Thieben & Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pierson, Roeding & Company
Western Electric Company
Westinghouse E. & M. Co.
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
General Electric Company
Moore & Company, Chas. C.
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
Fairbanks, Morse & Co.
General Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Pittsburg Piping & Equip. Co
Moore & Co., Chas. C.

Plugs, Flush
General Electric Company
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Pacific States Electric Co.
Western Electric Company

Pneumatic Tools
Rix Comp. Air & Drill Co.

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks, Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo. (Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Purifiers, Live Steam
"Hoppes," "Stilwell," Moore & Co., Chas. C.

Push Buttons
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
Pierson, Roeding & Company
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Regulators, Boiler Feed
"Copes,"Moore & Co., Chas. C.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

Searchlights
"Dayton," Elec. Agencies Co.
Fort Wayne Electric Works
General Electric Company

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, 159 New Montgomery
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco, 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Moloney Electric Co.
San Francisco, Rialto Bldg.

Moore, Chas. C. & Co.
San Francisco, 99 First
LosAngeles,AmericanBnkBldg
Seattle, Mutual Life Bldg.
Portland, Wells-Fargo Bldg.
Salt Lake City, Atlas Bldg.
Tucson, Arizona.

Nason & Co., R. N.
San Francisco,151 PotreroAve.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific States Electric Co.
San Francisco, 131 N. Montgy.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 703 Spaulding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco,MonadnockBldg

Post Co., The Frederick
San Francisco, 135 Second

Safety Ins. Wire & Cable Co.
San Francisco, 589 Howard

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
LosAngeles, Union Trust Bldg.

Tracy Engineering Co.
San Francisco, 461 Market
Los Angeles, Central Bldg.

Separators, Steam
"Stratton," Moore, Chas. C. & Co.
Pittsburg Piping & Equip. Co.

Shades
Benjamin Elec. & Mfg. Co.

Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
"Freeman," Elec. Agen. Co.
General Electric Company
Pacific States Electric Co.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.

Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Company

Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.

Surveying Instruments
Post Co., The Frederick

Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company

Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Steel Castings
Columbia Steel Co.

Street Cars
"Brill," Pierson, Roeding & Co.

Switches, Float
General Electric Company
Westinghouse E. & M. Co.

Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.

Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Westinghouse E. & M. Co.

Switches, Knife
General Electric Company
Pacific States Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.

Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.

Switches, Push Button
"M. & M." Elec. Agencies Co.
Pacific States Electric Co.

Switches, Snap
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Switches, Solenoid
The Cutler-Hammer Mfg. Co.

Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.

Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company

Tanks, Steel.
Western Pipe & Steel Co.

Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Company

Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Pacific States Electric Co.
Western Electric Co.

Tel. Protectors and Terminals.
"Cook," Elec. Agencies Co.

Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.

Towers, Steel.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company

Transformer Winding.
K-P-F Electric Co.

Tubes and Bushings
Ohio Brass Company

Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Moloney Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Trolley Bases
Ohio Brass Co.
Holabird-Reynolds Co.

Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.

Turbines, Water.
Pelton Water Wheel Co.

Valves
"Chapman," Moore & Co., Chas. C.
Pittsburg Piping & Equip. Co.

Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.

Washing Machines
Pacific States Electric Co.
Western Electric Company

Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee," Simonds Mchy Co.

Wire, Aluminum.
Pierson, Roeding & Company

Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company

Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.

Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company

Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Pierson, Roeding & Company
Standard Und. Cable Co.

Wire, Enameled.
General Electric Co.
Western Electric Company

Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company

Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.

Wire, Trolley.
Bridgeport Brass Company

Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
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Seattle, Central Bldg.
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San Francisco, 165 Second
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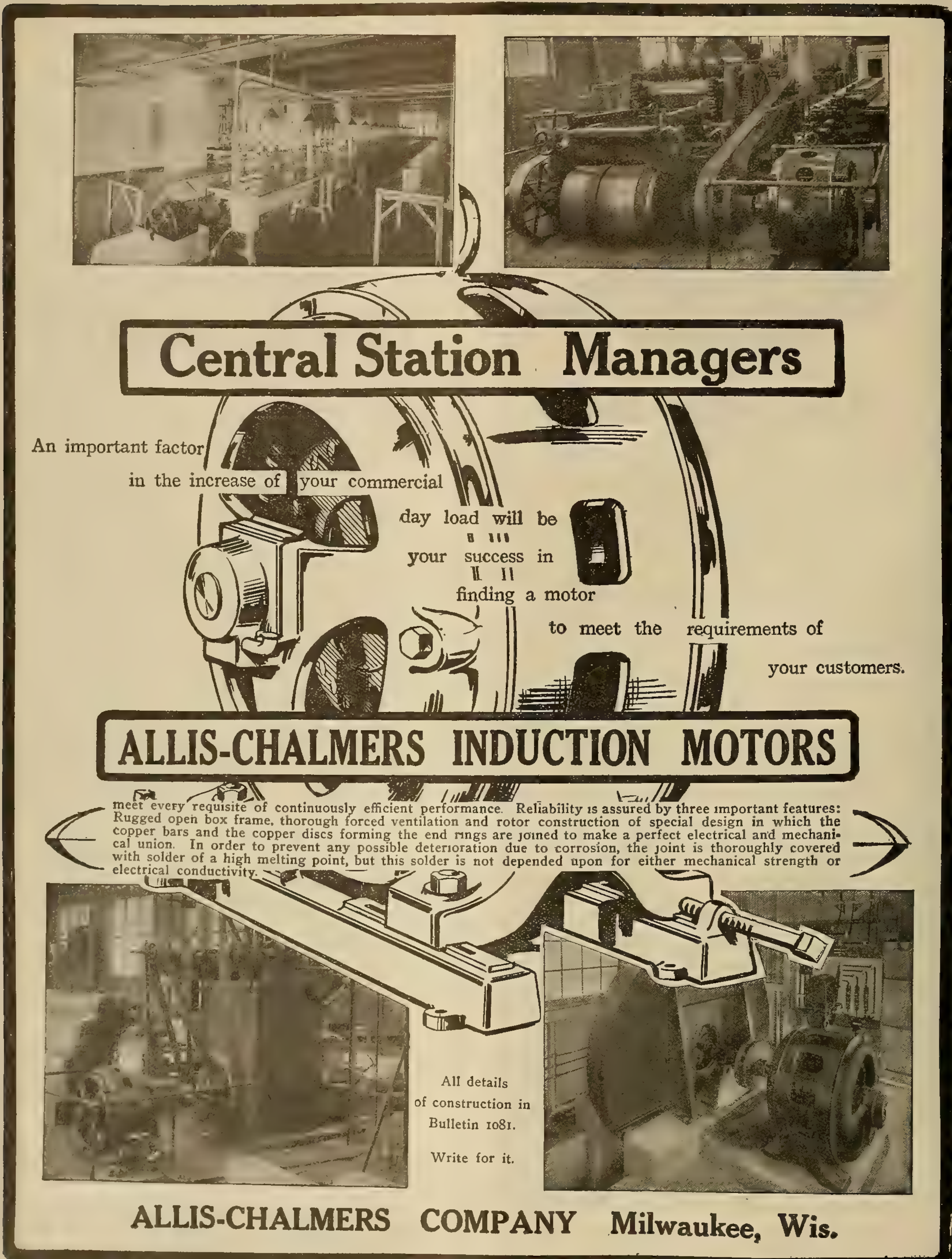
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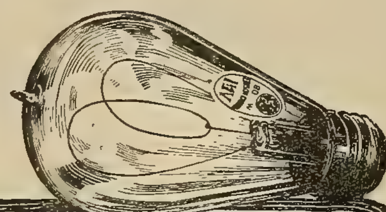

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXX No. 2 SAN FRANCISCO, JANUARY 11, 1913 PER COPY, 25 CENTS

LEADING ARTICLES IN THIS ISSUE

Publisher's Note: The front cover of this journal will hereafter be used to show the contents of the paper, both editorial and advertising. No further display advertising will be contracted for this space.

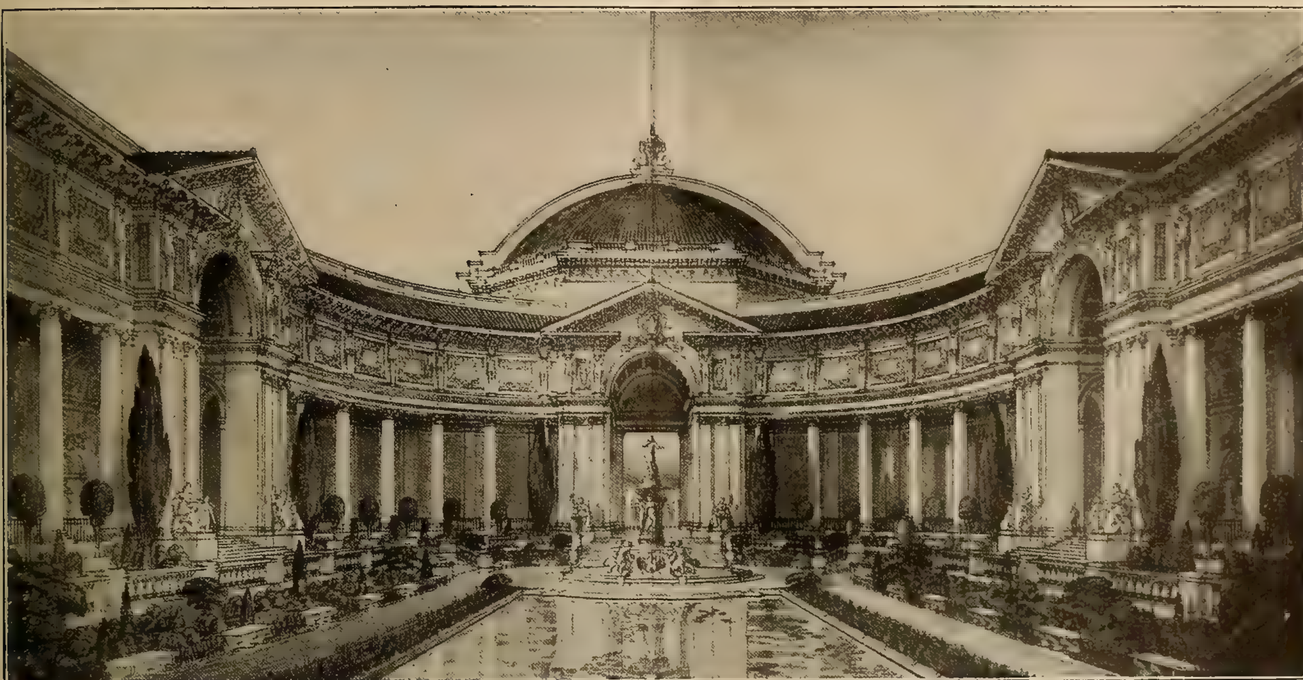
The Journal of Electricity, Power and Gas tells by picture and story of the wonderful power projects and electrical developments in that growing empire from the Rockies to the Coast.

MATERIALS ADVERTISED IN THIS ISSUE

Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX | SAN FRANCISCO, JANUARY 11, 1913 | NUMBER 2



The West Court of The Panama-Pacific Exposition.

ILLUMINATION OF THE PANAMA-PACIFIC EXPOSITION

BY FRANK A. BINFORD, JR.[1]

The problem of illuminating the Panama-Pacific International Exposition is more than the problem of supplying simply the amount of light necessary for seeing purposes. This exposition must be illuminated in a manner that is unique, distinctive, and that will leave a strong impression of individuality upon the visitor. The architect demands that the beauties of his colonnades and towers be brought out as well under artificial light as under daylight. The sculptor is not satisfied with a silhouette at night; his figures must have perspective, form, life. The artist, also, would like to see his great mural paintings appear in their true colors. These, and many other problems, have been solved, and it remains only to work out the details before the Exposition opens in 1915.

Fortunately, the great advances made in illuminating materials and methods during the last few years enable the illuminating engineer to do things that but a short time ago were impossible. Much new material has been developed especially for this exposition, and the work of development is still going on under the direction of Mr. W. D'A. Ryan, Director of the Illuminating Laboratories of the General Electric Company, and recently appointed Chief of Illumination for the Panama-Pacific International Exposition.

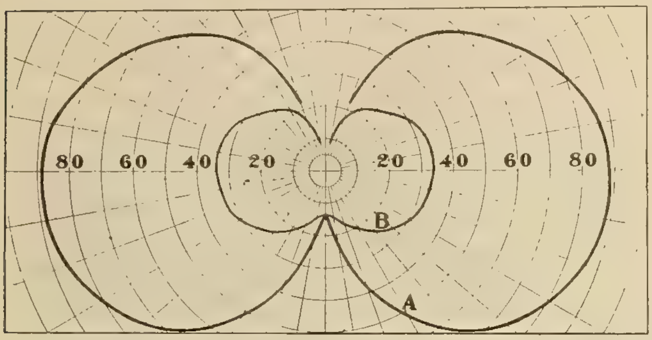
In Fig. 1 are shown the curves and data for the old carbon incandescent and the tungsten filament lamp. Both lamps are rated at 100 watts. The one gives a mean spherical candlepower of 28.1, the other gives 70.3 mean spherical candlepower, or two and one-half times the light for equal amounts of power.

The walls back of the colonnades in some of the courts of the exposition buildings will be covered with large paintings. The method of lighting these paintings by lamps placed in the back of the columns is shown in Fig. 2. Three lamps will be placed in each column at heights of about 10, 20 and 30 feet. The illumination on the paintings can be absolutely controlled in intensity and distribution by changing the size of the units and the curvature of the reflecting surface; and by introducing colored bulbs, any color effect may be obtained. The light from these lamps is

[1]Assistant to W. D'A. Ryan, consulting illuminating engineer for the Panama-Pacific Exposition.

distributed on three principal planes; the ceiling, the wall and the floor. Viewed from the plane of the ceiling or wall they would be seen as direct units, and thus have in this direction the high efficiency charac-

COMPARATIVE DISTRIBUTION CURVES
RELATIVE CANDLE-POWER FOR EQUAL WATTAGE
A—100 WATT MAZDA LAMP
B—100 WATT CARBON FILAMENT LAMP



	A	B
Mean Hemispherical Candle-Power	74	28.3
Watts Per Mean Hemispherical Candle-Power	1.35	3.52
Mean Spherical Candle-Power	70.3	28.1
Watts Per Mean Spherical Candle-Power	1.42	3.56
Downward Lumens	464	178
Total Lumens	883	353
Watts Per Mean Horizontal Candle-Power (Intern'l)	1.13	2.97

Fig. 1. Comparative Data on The Carbon Incandescent and Tungsten Filament Lamps.

teristic of direct lighting units. Viewed from the floor the two upper lights shown in Fig. 2 would appear as semi-indirect units, while the two lower lights would appear as indirect units; or by properly shaping the

DISTRIBUTION OF COLUMN LIGHTS
100 WATT MULTIPLE MAZDA LAMPS
WATTS PER MEAN HOR. C.P. (INTERN'L) CLEAR LAMP 1.13. B.F. LAMP 1.19.

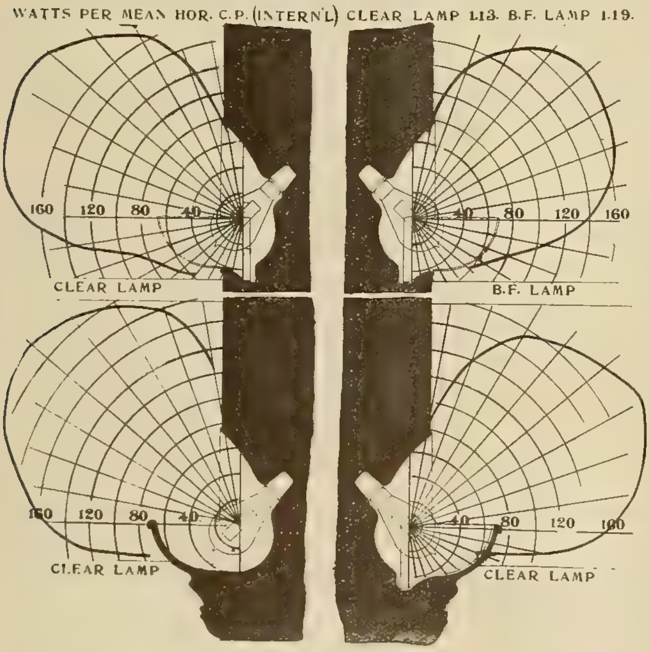


Fig. 2. Method of Lighting Paintings By Lamps Placed in the Back of Columns.

recess that contains the lamp, the source of light may be made entirely invisible from the floor, without any sacrifice in efficiency. This type if unit is for use on smooth columns. A special type of tubular lamp has been developed for fluted columns, the lamp and reflector being small enough to go into a flute of the column.

The recent development of the concentrated filament tungsten lamp marks an era in the history of incandescent lamps. A great deal of the development, especially in the larger sizes of lamp, has been carried out with the particular needs of the exposition in view.

In the theory of projectors it is shown that the intensity of a projector beam varies inversely as the square of the diameter of the source. It is thus evident that the diameter of the source should be as small as possible. In order to obtain the necessary degree of compactness the tungsten filament is first wound into a close spiral. This spiral is then looped about the supports in much the same manner as an ordinary straight filament, except that the loops are shorter and very much closer together. The result is a source that appears to the eye to be practically a point. There is no loss of energy due to the light caught in the inside of the spirals, as the energy this light all finally reappears on the outside of the spiral as light.

PROJECTOR FOR PANAMA PACIFIC INTERNATIONAL EXPOSITION

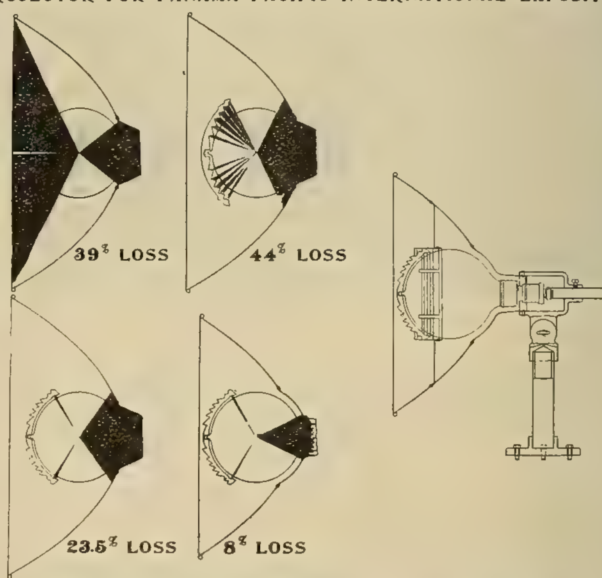


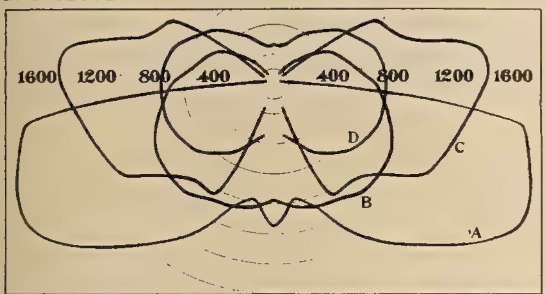
Fig. 3. Improved Projectors to Be Employed.

A study of the uses to which incandescent projectors are to be put in the Panama-Pacific International Exposition brought out strongly the two following points: First, a strong, well-defined beam is needed; and second, stray light from the projector should be eliminated. The method by which both conditions are fulfilled is shown in Fig. 3, which also shows the steps in the development of the projector, and gives the theoretical loss figures. These figures for losses do not include losses due to absorption or dispersion on the reflector, or losses due to dispersion, absorption and reflection at the lens. The actual performance figures will hold about the same relative values as given in Fig. 3, and thus the latter will do for purposes of comparison. In the cuts a vertical section of the lamp, reflector and lens is shown. The

shaded portions represent light that is lost because it is not brought into line with the beam from the projector. An ordinary parabolic reflector is shown in the upper left hand sketch. The light entering the base of the reflector and lamp is of course lost, and that

COMPARATIVE DISTRIBUTION CURVES

A—10 AMP. A.C. SERIES VERTICAL CARBON ENCLOSED FLAME ARC LAMP, FORM W, 60 CYCLES, CLEAR GLOBE
B—10 AMP. A.C. SERIES VERTICAL CARBON ENCLOSED FLAME ARC LAMP, FORM W, 60 CYCLES, ALBA GLOBE
C—6.6 AMP D.C. SERIES ORNAMENTAL LUMINOUS ARC LAMP, CLEAR GLOBE
D—6.6 AMP. D.C. SERIES ORNAMENTAL LUMINOUS ARC LAMP, PHENO GLOBE



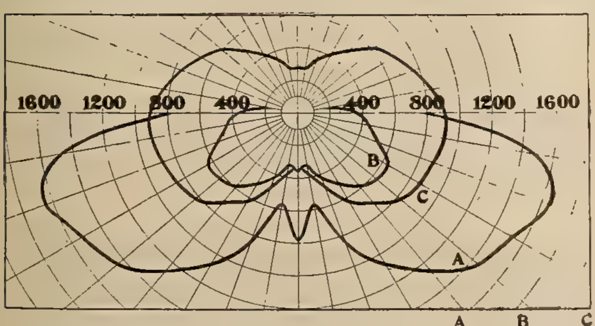
	A	B	C	D
Volts Terminal	60	60	75-80	75-80
Amperes	10	10	6.6	6.6
Watts	455	455	510	510
Mean Hemispherical Candle-Power	1527	850	1040	668
Watts Per Mean Hemispherical Candle-Power	0.30	0.54	0.49	0.76
Mean Spherical Candle-Power	775	609	845	629
Watts Per Mean Spherical Candle-Power	0.59	0.75	0.60	0.81
Downward Lumens	9610	5340	6531	4200
Total Lumens	9730	7650	10610	7920

Fig. 4. Distribution Curves for Various Lamps.

leaving the source within the shaded area in front is scattered. If an attempt is made to retract this scattered light into the beam from the projector by placing a semaphore lens in front of the source (top, right hand figure) the results will confirm the figures given.

COMPARATIVE DISTRIBUTION CURVES

A—6.6 AMP. D.C. SERIES LUMINOUS ARC LAMP FORM 6 MAGNETITE
B—6.6 AMP. D.C. SERIES ENCLOSED CARBON ARC LAMP
C—6.6 AMP. D.C. SERIES ORNAMENTAL LUMINOUS ARC LAMP FORM 10 MAGNETITE



	A	B	C
Volts Terminal	75-80	75-80	75-80
Amperes	6.6	6.6	6.6
Mean Hemispherical Candle-Power	1320	520	795
Watts Per Mean Hemispherical Candle-Power	0.39	1.0	0.64
Mean Spherical Candle-Power	696	301	725
Watts Per Mean Spherical Candle-Power	0.73	1.73	0.70
Total Lumens	8750	3780	9110
Downward Lumens	8300	3200	4993

Fig. 5. Arc Lamps of Equal Wattage Compared.

The beam will be weakened, and the reduction of stray light will be small. Due to certain peculiarities in the design of the ordinary semaphore lens, it scatters about as much light as it concentrates. Also, light that strikes the parabola near the base and is reflected in the line of the beam, is thrown out of parallel by the outer edges of the lens, and is added to the scattered light.

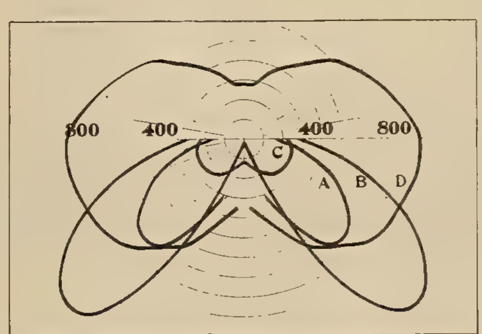
The next step was to design a special lens that would concentrate practically all of the light incident upon it. A section through this lens is shown in the lower left hand figure. There is still some light lost that is incident upon the base of the reflector. To correct this, the base of the reflector was made spherical. All light reflected from this surface strikes the lens at the proper angle to be refracted into the beam. The relative efficiencies of the four projectors, based on the conditions mentioned above, are 100 per cent, 92 per cent, 125 per cent and 151 per cent respectively.

A sketch of the assembled concentrated filament lamp, lens and reflector is shown on the right of Fig. 3.

The distribution curves and data given in Fig. 4 show the advance made in arc lamps from the time of the old 6.6 amp. d.c. series open arc to the present 6.6 amp. d.c. series ornamental luminous arc. The open arc had a maximum intensity at 45 degrees, with but little light directly under the lamp, or on the street and

COMPARATIVE DISTRIBUTION CURVES

A—6.6 AMP. D.C. SERIES OPEN CARBON ARC LAMP
B—9.6 AMP. D.C. SERIES OPEN CARBON ARC LAMP
C—6.6 AMP. A.C. SERIES ENCLOSED CARBON ARC LAMP
D—6.6 AMP. D.C. SERIES ORNAMENTAL LUMINOUS ARC LAMP FORM 10 MAGNETITE



	A	B	C	D
Volts Terminal	50	50	75-80	75-80
Amperes	6.6	9.6	6.6	6.6
Watts	330	480	425	510
Mean Hemispherical Candle-Power	382	736	232	795
Watts Per Mean Hemispherical Candle-Power	0.86	0.65	1.83	0.64
Mean Spherical Candle-Power	243	450	144	725
Watts Per Mean Spherical Candle-Power	1.36	1.07	2.95	0.70
Downward Lumens	2400	4620	1460	4993
Total Lumens	3050	5650	1810	9110

Fig. 6. Enclosed Flame Arcs and Luminous Arcs.

buildings beyond the 45 degrees zone. The type of lamp was superseded by the enclosed arc, having a distribution as shown in Curve C. Although the enclosed arc gave less light than the older arc lamp, on account of its superior distribution it gave better illumination, and had the added advantages of greater steadiness a lower intrinsic brilliancy, and a much longer life. Curve D shows a distribution that is admirably suited for illuminating the exterior of buildings as well as the street. This is the type of lamp that will be used on the exposition grounds. The light is white, and the colors of the buildings will be maintained at the proper values at night as well as during the day. A dense globe will be used and the intrinsic brilliancy of the lamp reduced to the point where it may be looked

at directly without any injurious effects on the eye. This is a very important thing in exposition lighting, for people are constantly looking about, and any exposed brilliant source is sure to lead to headaches and general irritability.

Data for three arc lamps of equal wattage are shown in Fig. 5. "A" is the 6.6 amp. d.c series luminous arc lamp so extensively used in street lighting, "B" is the enclosed carbon arc, and "C" is the ornamental luminous arc.

In Fig. 6 are shown the distribution curves for enclosed flame arcs and luminous arcs with clear and dense globes. The flame lamp has a distribution characteristic (see Curve B) that makes it well suited for lighting large inside areas, and this type of lamp will be used extensively for indoor lighting. At the St. Louis Exposition in 1904 the 6.6 amp. a.c. series enclosed carbon arc, Curve C, Fig. 4, was used extensively. This lamp takes 2.95 watts per mean spherical candlepower. The ornamental luminous and flame lamps with heavy diffusing globes have consumptions of about 0.78 watts per mean spherical candlepower. Thus, this exposition will receive nearly four times the light for an equal amount of power.

In making illumination calculations for the exposition a great deal of special work was encountered. No tabulations of illumination constants or other data are available for much of this work, and direct calculation is almost out of the question. The Illumination Chart[2] was used almost exclusively for the calculations so far carried out, some of which are shown in Figs. 7, 8 and 9. The method of using this chart is purely graphical, and is carried out on a draughting board. On the candlepower web near the middle of the chart is shown a section of the distribution curves of a 6.6 amp. d.c. series ornamental luminous arc lamp with a Pheno globe. The lamp is 15 ft. above the reading plane. In the lower left hand corner are shown four curves of horizontal illumination along four parallel lines in the reading plane. One line is directly under the lamp, and the other three are at distances from this of 25 ft., 50 ft. and 100 ft. There are more

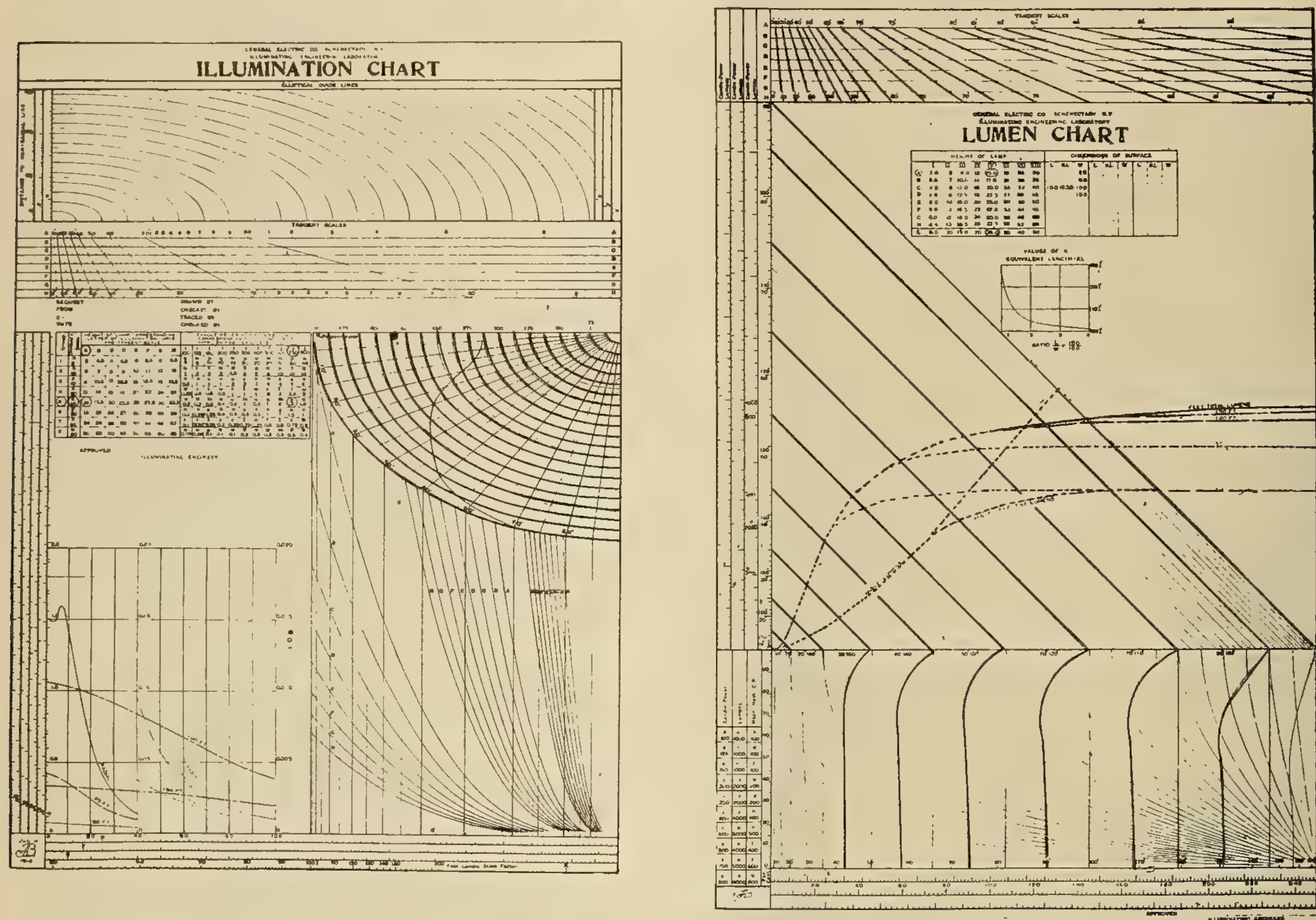


Fig. 7. Special Charts for Illumination Calculation.

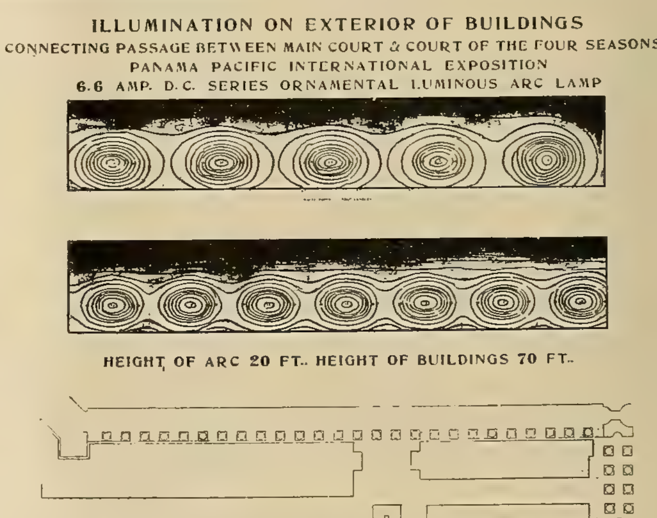


Fig. 8. Passage Between the Main Court and the Court of Four Seasons.

[2]For a description of the chart see a paper read before the Illuminating Engineering Society, Niagara Falls, Ont., Sept. 16-19, 1912.

than 40 distinct kinds of illumination curves that may be calculated on this chart.

On the right of Fig. 7 is given a reproduction of a Lumen Chart. This chart is used for calculating the total lumens that fall within any given area. By means of this chart the figure for lumens per square foot, and several other similar figures may be readily obtained for any given case.

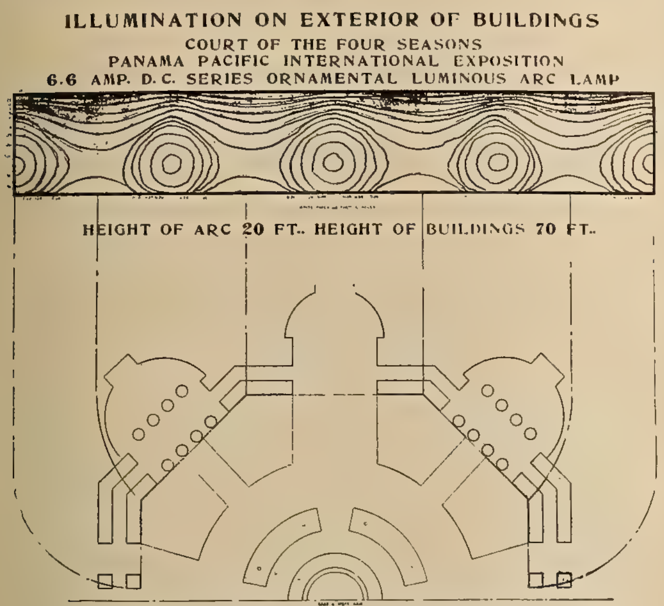


Fig. 9. Walls of the Court of Four Seasons.

At the bottom of Fig. 8 is shown a half plan of the connecting passage between the main court and the court of the four seasons. Two spacings of lamps are shown, one for seven lamps on a side, and the other for five on a side. Above the plan are the corresponding isolux diagrams for the illumination on the walls of the buildings. The lamp used in this and the following isolux diagrams is the 6.6 amp. d.c. series ornamental luminous arc lamp with a Pheno globe. In the original drawing these diagrams are accurately shaded to show the relative illumination on the different parts of the building. In the process of reproducing these diagrams the shading is distorted and the difference between the light and dark parts greatly exaggerated. The proper shading is obtained very accurately by comparing it with a strip of the same paper that has been shaded from pure white to jet black and then calibrated in a photometer. Under even illumination these diagrams give a very good idea of the actual results obtained in practice.

The illumination on the walls of the court of the four seasons is shown in Fig. 9. There are eight standards arranged in a circle around the center of the court, and the calculations were made for one lamp per standard. The number of lamps that will actually be used may be anywhere from one to ten. If more than one lamp per standard is used the resultant illumination may of course be obtained by multiplying all the foot-candle figures by the proper factor.

The main court of the exposition is to be illuminated by the light from two large fountains on the main axis of the court. These fountains will be constructed of dense white glass, and in the daytime will in no wise suggest light sources. Within each fountain there will be 72 arcs, a total of 144 for the court. When these arcs are lighted at night the entire surface of the fountain will become luminous, flooding the court with a softly diffused light. In Fig. 10 is shown a plan of one quarter of the court, and above it a development of the walls about the court with isolux lines showing the illumination from the two central fountains. In the diagram the illumination is calculated up to a point about twice the height of the buildings. This was done to include several towers and arches that extend above the general building line.

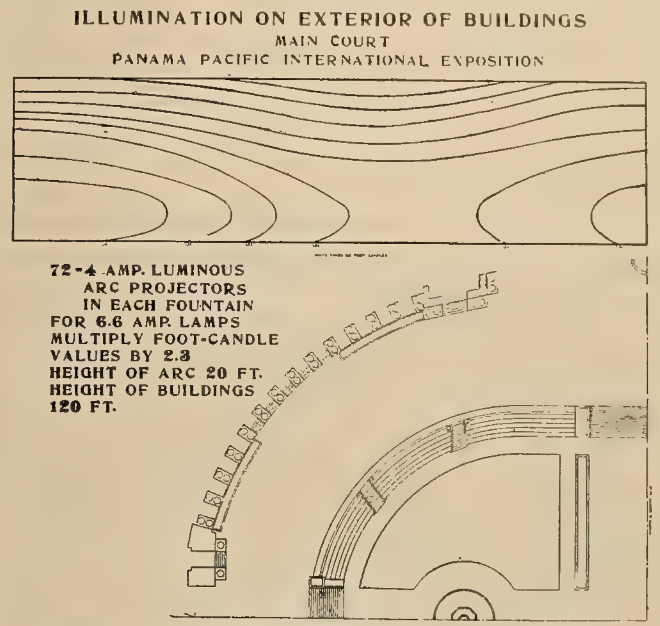


Fig. 10. Illumination Main Court Panama-Pacific Exposition.

SWISS USE OF GAS FOR COOKING.

The use of gas for cooking in Switzerland is very extensive and is on the increase. In 1893 there were 3714 gas meters in the city of Zurich, 87 per cent of which measured gas used for lighting and 13 per cent for technical, cooking, and heating purposes. In 1910 the number of consumers had increased to 47,376, and only 26 per cent used gas for lighting, while 73 per cent of the total number were consumers of gas as fuel for cooking and heating, and the remaining 332 meters registered the amount of gas consumed for technical uses and gas motors. Corresponding increases have taken place in other large cities of the Confederation.

These conditions have made the manufacture of gas cooking stoves and apparatus an enterprise of much promise. There are now four or five plants of this sort in Switzerland (the largest being the Schweizerische Gasapparaten Fabrik at Solothurn), which not only supply much of the domestic demand for such articles but also export considerable quantities to South America and other countries. The value of the exports of stoves and ovens in 1911 was $74,719, of which about one-third was gas stoves, exported chiefly to Argentina, Italy, Brazil and Chile. It is estimated that the value of the product of the Swiss manufactories of gas cooking apparatus is between $150,000 and $175,000 annually.

ARTIFICIAL TRANSMISSION LINES[1]

BY H. F. FISCHER.

The phenomena which are now becoming of the very greatest importance to the electrical engineer, due to the dependence thereon of further advances in the art, are those transient phenomena of waves, impulses, surges, etc.

The conditions of the steady flow of power are fairly well known today and results to be expected in any particular case can usually be predetermined more or less accurately.

The limitations of apparatus are not always determined by the normal conditions of operation, but rather by abnormal, although not unusual, operating conditions, and it is easily apparent, with greater concentration of power, longer transmissions and higher voltage apparatus that the study of transient phenomena becomes of increasing importance, and it is therefore not surprising to observe the active interest shown of late in the design, construction and testing of various artificial transmission lines.

By artificial transmission lines (as considered in this paper) are not meant the experimental lines for the study of high voltages, but rather what might be termed sluggish or slow speed conductors for the study of transient phenomena, regulation, etc.

Such artificial transmission lines are not alone interesting theoretically, but have in one instance at least very direct practical application. The speaker has in mind a case where the entire transmission system of a power company has been faithfully duplicated in their laboratory, for the sole purpose of developing and trying out various relays, etc., with the idea of eliminating destructive influences under various conditions of operation and thus insuring, to the highest possible degree, continuity of service.

In long transmission lines, the consideration of line resistance and line reactance is by no means sufficient to explain actual line phenomena, but we must include the consideration of distributed line capacity and line leakage.

The general case of a long distance transmission may be then attacked if we consider the circuit as having four line constants, (mere physical constants theoretically independent of frequency or voltage) which are

r = resistance per unit length.
g = leakage conductance per unit length.
L = self induction per unit length.
C = electrostatic capacity per unit length.

Furthermore, we know by experiment that the velocity of an electrical impulse over a conductor is approximately equal to that of light or very nearly 186,000 miles a second. Considering, for a moment an open circuited transmission line, an impulse starting from the generator end would travel approximately at the velocity of light, to the open end of the line and be reflected back toward the generator at the same velocity. Should a second impulse be sent out by the generator at the instant that the reflected wave reaches the generator, the two impulses would be added together and we would have the case of a gradually increasing impulse, building up with each second reflection. Such a condition is called resonance and it is readily seen that for an alternating current circuit open at the far end the resonant frequency would be expressed by the relation $f_0 = \frac{S}{4L}$ where S = velocity of light and L = length of transmission.

Assuming an impressed frequency of 60 cycles, the line would have to be approximately 780 miles in length in order to have a natural frequency of 60 cycles or contain one complete wave length.

It is therefore apparent that even the longest of present day transmission lines is but a fraction of an electrical wave length of commercial frequency. Conversely, any transmission circuit may have its length expressed as a function of the impressed wave length. The equation expressing this condition contains the four line constants already mentioned, and in such a form as to indicate that any duplication of the original line must have the same total resistance, total reactance, total leakage conductance and total distributed capacity.

The ideal artificial transmission line would then be a built up electric circuit, so designed as to represent an actual or proposed line for the transmission of electric energy either for power, telephonic or telegraphic application, and having total resistance, total inductance, total distributed capacity, and total leakage conductance as possessed by the line to be duplicated.

Practically, it is impossible to represent a line of any considerable length by means of a single continuous coil or circuit, but artificial line units may be built, each unit or section possessing the four line constants in the same ratio as in the actual line to be duplicated, and then employing a sufficient number of these artificial units to make up or equal the total value of the line constants to be duplicated. In building artificial transmission line units then, the ratio between the line constants must be preserved, irrespective of their magnitude.

The next consideration then is, what voltage and power shall be used on the artificial transmission line, it being entirely out of the question to actually use more than a fraction of the voltage and power transmitted on the line to be duplicated, if it be a power transmission.

The limiting operating conditions for the artificial transmission line are usually the voltage to be handled or the available output from a laboratory generator. Assuming the former to be the case, it is a simple matter to calculate the percentage resistance drop for the actual line and then apply the same percentage resistance drop to the artificial line voltage.

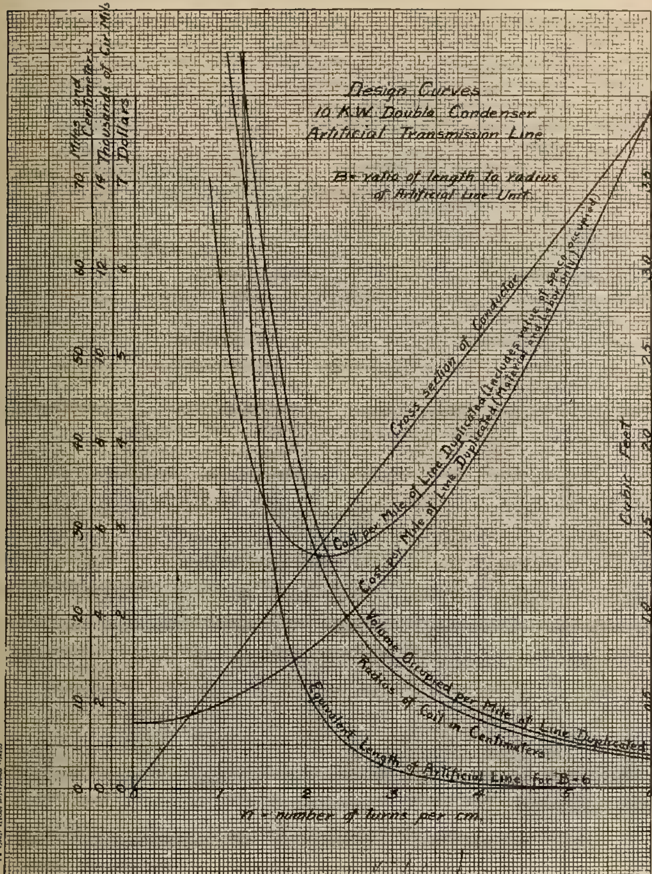
Since the total resistance on both the actual and the artificial line is the same, it is immediately apparent that the current to be transmitted over the arti-

[1]Read before the San Francisco Section, A. I. E. E., Nov. 29, 1912.

ficial line bears the same relation to the current in the actual line as does the voltage in the artificial line compared to the voltage in the actual line.

From the preceding, it follows immediately that the power to be transmitted over the artificial line varies as the square of the voltage ratios.

Having fixed these ratios, it will be found that the same relations will hold for the inductive, capacity and leakage effects, and the artificial transmission line will when so designed give results which are directly proportional to those in the actual line.



Design Curves for Artificial Transmission Lines.

There are two general methods of constructing artificial transmission lines, namely either as "lumpy lines" or as "smooth lines," these expressions being ascribed to Dr. Kennelly.

In general the distinction between these lines is as follows:

In "lumpy lines" the total line resistance, reactance, capacity, etc., is made up of impedance units or coils in series and small condensers shunted across the line at close intervals to represent line capacity.

"Smooth lines" are so constructed that a perfectly even distribution of capacity, resistance and inductance is obtained by wrapping the wire representing the actual transmission line over or between layers of tinfoil or other material suitable for giving distributed capacity effect.

"Lumpy lines" are by far the easiest and cheapest to construct but their usefulness is confined largely to problems in line regulation and other steady energy flow problems, etc., and not to the study of transient phenomena.

"Smooth lines" on the other hand, are considerably more expensive and more difficult to construct, but the even distribution of capacity makes it possible to study under actual line conditions, and without correction factors, all forms of transient phenomena and in addition all regulation phenomena.

An excellent description of a "lumpy line" as constructed and permanently installed in the Graduate School of Applied Science at Harvard, is contained in a paper by A. E. Kennelly and F. W. Lieberknecht, presented before the last annual convention of the Institute at Boston.

In general "lumpy lines" may be classified under two heads, namely "T" lines or π lines, the only difference between the two types being in the distribution of their terminal elements.

In the "T" design, the transmission line would be built of series impedance units, each with one middle tap to which the shunt condenser is attached.

In the π line the same series impedance and shunt condenser units would be used, with the exception that the condensers would tap in between successive series impedances.

As actually constructed, each series impedance in the Harvard line, representing approximately 50 miles (49.7 mi. or 80 km.) of line, consists of four-sided wooden frame, approximately 14 in. over the outside corners, with free winding space along each leg approximately 8 in. long and perhaps ⅜ in. deep. Each limb of the frame is wound with 1190 turns of No. 19 A.W.G. wire. The object in view when building the impedance models in the form of a four-sided frame was to obtain as nearly as may be a closed magnetic circuit, thus increasing the effective self inductance of each frame and diminishing the external stray magnetic field as far as was conveniently practicable.

The condensers were built of tinfoil and paraffined paper, each condenser unit being enclosed in a tinned box filled with paraffine.

The impedance frames are assembled at right angles to each other so as to reduce their mutual inductance to a minimum, the connections between successive line units being made by means of contact plugs. In this manner the transmission line can be opened at any convenient point and by means of a split plug voltage and current readings are obtained at any time.

The artificial line is notable because of its length, there being sufficient impedance units and condensers available to imitate approximately 500 miles of three phase, star connected line or nearly 1500 miles of single-phase line. The tests outlined in the above mentioned paper were made on approximately 645 miles of this line and as such stand by themselves as the only tests on record over artificial lines of anything like this length.

As far as the writer can observe no startling results have been obtained on this line, all the recorded measurements and observations checking the hyperbolic function theory of such lines within the limits of precision of the measuring instruments.

The second or "smooth type" of line has been described in a paper by J. H. Cunningham, presented before the midyear convention of the Institute in February, 1911.

This line has been designed, built and tested in the Electrical Laboratory of Union College, Schenectady, New York, and differs materially from the one already described.

After consideration of various methods, the type of construction finally adopted was to wind suitably sized wire over hollow glass cylinders approximately six inches in diameter, ⅛ in. thick and 4½ ft. long, each cylinder containing 240 turns of No. 8 B.&S. gauge copper wire. The tubes when finished were assembled in racks of ten rows with ten tubes per row.

In order to obtain distributed capacity, the inside surface of the glass tubes was coated with much difficulty with a layer of tinfoil, held in place by fiber strips and phosphor bronze expansion rings. It seems that great care had to be taken in building these line units since even the phosphor bronze expansion rings were liable to crack the glass cylinders.

As finally completed each unit of this artificial transmission line represents approximately .325 miles of an actual line built with No. 1 B.&S. gauge copper wire, having a spacing of 5 ft. between wires; the total equipment of 400 tubes being equal to approximately 130 miles of such construction.

Such a line, in spite of the increased cost of construction and greater mechanical difficulties, gives an ideal duplication of actual line relations and for certain phenomena is the only type that can be successfully utilized, and it is this type of line that is proposed for experimental research at the University of California.

The mechanical construction however will be slightly different and the final design investigated will permit of some degree of flexibility not inherent in the two artificial lines already described.

A rather complete investigation of the principles of artificial transmission line construction was made a year ago by Mr. F. E. Pernot as a thesis in partial fulfillment of the Master's Degree at the University of California, and it will be largely from Mr. Pernot's paper that data for the proposed type of construction is obtained.

Instead of using fragile glass cylinders, it is proposed to build hollow cylinders of well seasoned wood, suitably treated and wind thereon a layer of fairly heavy tinfoil. This tinfoil layer will be slit longitudinally to prevent its acting as a short circuited transformer turn, and in addition will be slit part way around the circumference, at intervals of a few inches, to reduce eddy currents.

Over this layer of tinfoil will be wrapped a sufficient thickness of insulating material (it has been proposed to use something similar to varnished cambric or treated cloth) and then wind the required number of turns of copper ribbon over this in order to provide sufficient line inductance.

Now, if it is desired to obtain an artificial unit of different line constants it is only necessary to wrap the necessary amount of insulating material over the first winding layer and place another layer of tinfoil over this, thus doubling the capacity without affecting the inductance. This might be carried out further by providing additional layers of coil winding, etc., but for the present only the single and double condenser sheet artificial transmission line units have been considered.

In order to improve the mechanical construction and use the surface of the wire most effectively for capacity effect, all consideration of round wire has been omitted and only flat copper ribbon of suitable dimensions will be used.

As in the case of almost every engineering problem there is a most economical solution, nor has this point been overlooked in the design of the proposed line. The most convenient equation for the economical solution is an expression for n = the number of turns per inch length of the cylinder and is of the form

$$n = \frac{v F R k^2}{2c\,(2\pi)^3\, p\, w\, q\, J\, (9d)^2 10}^{\,1/4}$$

Where

v = value of space occupied per unit volume and cost of construction per unit volume.
F = some constant = M/J.
M = coefficient of self induction per unit length.
J = electrostatic capacity per unit length.
R = resistance per unit length of actual line.
k = dielectric constant of material used in artificial line.
c = correction factor for inductance formula.
p = resistance per unit volume of material used for conduction.
w = weight per unit volume of material used for conduction.
q = cost of conduction material per unit weight.

However, the most economical solution for an artificial line is but one of the determining factors. As already mentioned the voltage, current and power to be transmitted bear a certain relation to the actual line voltage, current, etc., and having determined on a suitable working voltage, we find that the capacity of a given artificial transmission line may be further limited by the dielectric strength of the insulation between the winding and condenser sheets and the heat radiating ability of the outside surface of the coil; the former limiting the voltage and the latter the current.

The maximum difference of potential between the winding and condenser plate is obtained during the occurrence of a surge in the line due to sudden changes in circuit or load conditions. For the proposed line this has been taken as approximately twelve times the normal operating voltage.

Furthermore, for mechanical reasons a ratio of coil length to coil radius of 6 has been chosen as being suitable.

It may be of interest to see how an artificial transmission line of 10 k.v.a. capacity to duplicate a 250 mile transmission of 6 cables with 10 ft. spacing between wires will work out.

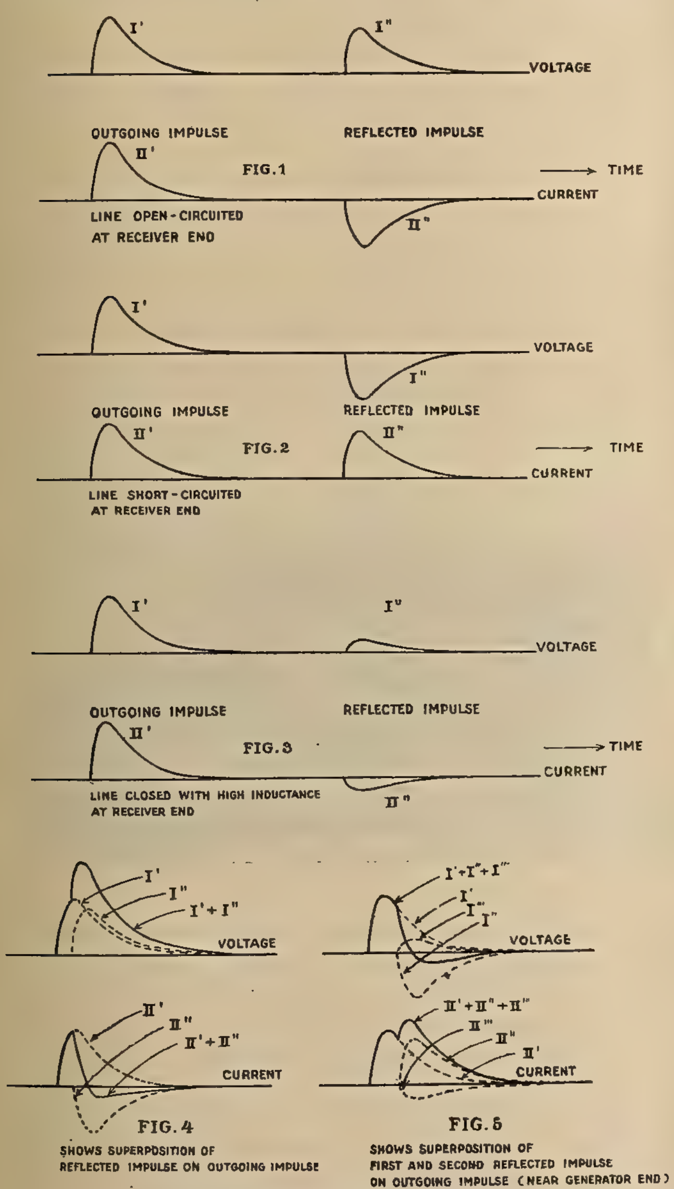
Representative line, 140,000 volts.
250 miles. Six cables. Ten-foot spacing between wires.
Six strands No. 7 copper per cable. 124,920 circular mils.
Resistance per mile = R = 0.4317 ohms.
M = inductance to neutral per wire = 0.00211 henrys.
J = capacity to neutral per wire = 0.0141 micro-farads,
At 81,000 volts to neutral at receiver, a load of 60,000 kw. for the six cables = 10,000 kw. per cable.
At 25 cycles, regulation = 24 per cent.
At 60 cycles, regulation = 34.5 per cent.
For 10 kw. on artificial line

$$E' = \left(\frac{10}{10{,}000}\right)^{1/2} \times 81{,}000 = 2{,}560 \text{ volts.}$$

$$I' = \frac{10{,}000}{0.95 \times 2.560} = 4.12 \text{ amperes.}$$

Before closing it may be of interest to discuss some of the results actually obtained in tests on the smooth artificial transmission line at Union College, New York, with particular reference to the propagation of impulse.

In general it may be stated that an electromagnetic wave or impulse is an energy manifestation; the energy appearing in two forms; that of the die-



Varying Impulse Curves in Transmission Phenomena.

lectric or electrostatic field proportional to the potential difference and that of the magnetic field proportional to the current. Through these two components, viz., voltage and current, it is possible for us to make complete oscillographic studies of such electric impulses.

It is furthermore true that conversion from one form of energy to the other form may take place under proper conditions; that is to say, the magnetic field energy may be converted to electric energy and vice versa. This is the true fundamental phenomena underlying the following discussion, but for simplicity the intermediate process of conversion taking place during reflection is omitted and the original and reflected components are assumed as following one another directly.

Consider for a moment a transmission system open circuited at the receiver end. We find that an impulse impressed at the generator end will travel toward the receiver, very nearly at the velocity of light (were it not for the inductance and capacity the velocity would be that of light), but having arrived at the far end of the line it will not remain there if it can find a possible outlet. Obviously no other outlet exists except via the route it came by and the observed effect then is that the current component in order to return must reverse in direction and on the oscillographic record the reflected current wave actually appears so. On the other hand, the component wave proportional to the potential difference, is observed to be unaffected by the open circuit and the reflected potential wave appears to be of the same characteristic shape, polarity, etc., as the outgoing potential wave. If the line experimented upon were infinite in length, the wave would travel out over it until all its energy is dissipated whereupon it would vanish. With a line of finite length, the energy wave is reflected back and forth from end to end until all of its energy is dissipated and the impulse vanishes. Assuming a line sufficiently long that the original impulse will not be affected by the reflected impulse, the conditions for an open circuited line would be similar to Fig. 1.

If we consider the case of a transmission line short circuited at the receiver end, we find as before that the energy impulse having arrived at the far end will not remain there if it can find a possible outlet. In this case the current component will not reverse in direction, but will merely travel onward over the return conductor after reaching the short circuit. The component proportional to the potential difference however upon reaching the short circuited end is reflected reversed and appears as such on the oscillographic record as shown in Fig. 2.

With a condition intermediate to the two already described, that is, a line neither open circuited or short circuited, but having some form of resistance inductance or even another transmission system of different line constants connected across the receiver end, we find conditions of reflection intermediate to thos named. For instance a high inductance shunted across the receiver end of the line would act more like an open circuit and it would be found that the greater proportion of the current component is reversed and reflected, only part of it passing back on the return conductor through the inductance. The greater proportion of the voltage component is unaffected as though the line were open, only a part being reflected reversed due to the short effect of the inductance. This is plainly indicated in Fig. 3.

We find that for lines of ordinary length the outgoing impulse has no time to die away before the reflected wave is superimposed on it and as a consequence we obtain oscillograms such as shown in Fig. 4 and 5.

The excellent paper by J. H. Cunningham and C. M. Davis in the May, 1912, proceedings of the A.I.E.E. discusses this phenomena very fully besides illustrating it with observed oscillographic records.

READINESS TO SERVE METHODS

MODERNIZING THE HOUSE.

BY R. B. MATEER.

Only a few years ago many square miles of land covered with sage, or known as desert, were to be found in the West, unproductive and unsought, as agriculture was not deemed the road to great wealth. Here and there a rough redwood shack stood as the mute evidence of an effort to secure something for almost nothing. Many a wandering farmer, finding himself isolated in an unknown land, had relinquished his partially purhased property and sought other labor, where a daily wage was direct return for time served.

Yet from the East came a few settlers possessed of those qualities which today have made the great empire of the Pacific Coast. They secured a title to the land, and, true to their ideals, toiled long, forcing from the earth a livelihood. The shack, with its one room and hard earthen floor, gave place to the comfortable cottage, and later to the large house, the center of all activity on the ranch, which now occupies a commanding position on the once desert waste.

Thrift resulted in structures of imposing exteriors; comfort demanded the use of modern conveniences within. The shack was usually equipped with a few bunks and a stove adapted only to the burning of wood. The candle provided the necessary illumination. In the cottage a base burner gave warmth, the coal range the heat for cooking, the oil lamp the light, all of which were at first in evidence in the larger home.

Convenience demanded other means of illumination, and the gasoline lighting system was installed for both light and fuel purposes. Yet as the oil lamp gave way to better general illumination and the coal stove to convenient fuel-consuming appliances, so those of gas must now yield to the improved "snap of a switch" type.

The old-fashioned stove has been superseded by the efficient and convenient electric range, with the ease and simplicity of heat control. The 40-gallon tank is now heated with a three kilowatt electric water heater, arranged with a thermostatic cut-out, supplying at all times in quantities large or small and at a uniform temperature.

A power table, equipped with an adjustable coffee mill, dough and cake mixer, meat grinder and cream freezer, the mechanic of the kitchen does the work of several pair of hands at a minimum of expense. Panel outlets equipped with push-prong jacks for small table appliances complete the equipment of the kitchen. In the basement is found the labor-saving electric washing machine, and the motor-operated, electrically heated mangle, with several irons, varying from 5 to 7 pounds, for pressing purposes.

Complete so far as laundry and kitchen, yet continuing our tour of inspection, we find the dining room equipped with baseboard and floor receptacles arranged for the use of any one or all of the several appliances, the percolator, toaster, grill and chafer, which are seen to occupy important places on the buffet.

In the living room and library ample provision is found for portable luminous heaters and numerous reading lamps. The bath and chambers are equipped for the use of heater, pad and night lamp.

Complete from the viewpoint of convenience and comfort, but what of the operating cost? What of the investment necessary that a family may enjoy electric service?

Operating Costs.

Some tests recently completed indicate the average monthly consumption of energy for cooking purposes to be 120 kw. in the family of four or five persons. A washing machine used eight hours a month consumes 2 kw., and an iron in use for twelve hours a month will require 6 kw., while a like amount of current is needed for the operation of the mangle each thirty days, a total monthly consumption of 134 kw.

A Rural California Home Electrically Equipped

hours for all laundry and kitchen purposes. Data at present available indicates a monthly consumption of 75 kw. per 40-gallon tank, a grand total of 209 kw., which, at a standard heating rate of 3 cents per kilowatt hour, would amount to $6.27 per month.

The monthly consumption of luminous heaters is subject to variation, as the number of hours' usage are dependent on the climatic conditions and the general health of the occupant of any portion of a house heated electrically. It is, however, safe to figure that the average heater will continue in use each day of the cool months for a period of three hours, or monthly some ninety hours. Where the lamps used are of 250 kw. a maximum monthly consumption of 45 kw. hours per heater can be added to our total.

Convenience dictates at least two such heaters for each country home.

The toaster, the percolator and other appliances used on the table total 30 kw. per month, a grand total of 429 kw. for domestic and heating purposes, or $12.87 per month for heat, when and where desired, and in such quantities without waste as to indicate a high efficiency.

The illumination of the house with tungsten lamps arranged to secure a maximum of light without sacrificing the aesthetic taste of the occupant is accomplished on a consumption of 40 to 50 kw. hours per month, including such current as is desired for the lighting of the porch, an expense varying from $2.80 to $3.50. Light and heat for all household purposes at an average monthly expense of $15.67.

Compare, if you please, the cost of the clean, wholesome electric service with a similar service obtained by the use of coal or wood and their accompanying dirt, or with oil fuels and the constant increase in unit cost, and convincing proof is easily secured, blazing the path of progress to that fuel obtained by the use of "white coal," the gift of nature, and found in such large quantities on our mountain slopes.

Investment.

The equipping of the kitchen, laundry, dining room and chambers with current-consuming appliances means an investment of from $275 to $350, the price the farmer is willing to pay that his home may possess every comfort and convenience. His thrift built the castle, and the appointments within must equal, and many times surpass, the pleasing exterior. While his policy is to secure that which is the most economical and serviceable, his investment in electrical appliances becomes an asset, recognized as such by his neighbors as well as the assessor.

That which possesses value is sought, and the first cost is only considered on a basis of value received. The old coal range, merely a combination of cast iron, is worth but little after delivery to the purchaser, while the electric stove commands its price after much usage. Depreciation is less of a factor in electric current-consuming apparatus than in the older forms of reputed household comforts.

Facts.

It should be remembered that electric appliances have now reached a stage closely approaching perfection, and that the lack of durability, the slowness in heating, and the current consumption complained of a few years ago were no more serious than the faults found with the early coal range; and that as practical applications soon remedied the faults, so today has the early imperfection of the current-consuming appliance been overcome—to such an extent that in one city 40 complete equipments are in use; in another 115, and in a third over 300, and that with the eagerness of the farmer to possess all that may be found in a city home, combined with his known ability to assimilate readily all expense connected with the installation of electrical apparatus such as tends to modernism, the time is not far off when every country home will be equipped as the one briefly mentioned, and yield to the utility that is ready to serve "juice" a handsome return accruing from a load of such character as to be eminently desirable.

More and more it is evident that the expense of educating the urban resident to modern developments of current-consuming appliances and their use is greatly in excess of that incident to the actual sale of apparatus to the farmer, who is the first to grasp the fact that the electrical era in the home is now here, and not a future possibility.

Cooking and heating by electricity is not only feasible, but an accomplished fact, and its growth depends on the activity of the central station in providing the necessary transmission wires and co-operating with the farmer in providing a stock from which he may have his choice, realizing that "the farmer is the one indispensible man. His industry is the industry of society. The real and fundamental prosperity of any state is rooted in the soil."

ELECTRICAL PUMPING AND IRRIGATION

RETAINING WALLS FOR CANALS.

BY B. A. ETCHEVERRY.

(Continued.)

Tunnel No. 2, 308.7 ft. long, did not require timbering as it was a compact red rock without seams. The tunnel was lined with an average thickness of 8 in. of concrete. It required about 2 cu. yds. of concrete per lineal foot. The actual cost to the contractor for the tunnel was:

Tunnel.	Length.	Cost of driving and timbering.	Concreting cost per cubic yard.		Total cost per lineal ft.
1	901	25.63	1567 cu. yd.	@ 7.165	38.086
2	308.7	16.45	619 cu. yd.	@ 8.325	34.149
3	1515	23.76	2879 cu. yd.	@ 6.596	36,299
4	213	26.02	320 cu. yd.	@ 6.918	36.414
	2937.7	23.73	5385	7.086	36,561

This does not include cost of cement or extras nor contractors' profits. The cost of cement was approximately $2.55 per barrel, which, allowing 1 barrel of cement to 1 cu. yd. of concrete would bring the cost of concrete to $10 per cu. yd. or a total cost per lineal foot of $43.00.

Belle Fourche Project Tunnel Lining.

On the south canal of the Belle Fourche project a tunnel of the horseshoe type has been constructed. The length of this tunnel is 1306 ft. and it is designed to carry 320 second feet. Where necessary the tunnel is timbered and above the arch the entire space is completely filled with hard stone so placed and wedged that it will carry the load uniformly to the tunnel arch.

Forms of Concrete.

The forms used in lining are of a very good type and have been entirely satisfactory. The work was done by force account for about one-third of the lowest bid. The forms consist of frames made up of two I beams bent to the proper shape, connected together at the top with a wedge shape key block placed with a channel bolted to the beams and holding them the proper distance apart. The foot of the I beams rest on the footing course. The frames are spaced 4 ft. apart center to center. On these frames rest the lagging 8 ft. long and built up of 1 in. lumber to conform to the shape of the tunnel and in widths of 20 to 24 in. and strongly braced. This lagging can be put on or taken off in section. The I beam frames can be taken

apart and moved ahead without disturbing the forms of the new work. In this manner the work can be carried on continuously. Many of the forms commonly used for tunnels or siphons can not be handled in this way.

The concrete used was a mixture of 1:2½:5. The length of the tunnel was 1306 feet. The actual quantity of concrete placed in the lining was 1.595 cu. yds. Under the requirements of the specifications, had the contract been awarded, payment would have been allowed for 1712 cu. yds. The accuracy of the excavation work reduced the quantity. The sand and gravel for the concrete were obtained at one end of the tunnel from natural beds and the concrete was mixed at this point. The wages paid were $2.30 per 8-hour day. The cost of construction exclusive of charges for survey and designs is as given below. The units costs given are based on 1712 cu. yds.; the unit cost based on actual number of cu. yds. is about 8 per cent greater.

Distribution of Cost.	Total Cost.	Cost per cu. yd.
Preparation expense	$ 731.30	$0.43
Plant depreciation	725.73	.42
Superintendence	318.00	.42
Superintendence	318.00	.81
Camp maintenance	430.03	.25
Cement	4,544.11	2.65
Lumber and steel forms	861.08	.50
Miscellaneous materials	45.20	.03
Fuel	105.14	.06
Lighting	81.43	.05
Miscellaneous supplies	230.80	.14
Hauling cement	1,624.25	.95
Hauling gravel and sand	432.32	.25
Crushing and screening gravel and sand	205.17	.12
Mixing and placing concrete	1,565.71	.92
Hauling forms	106.95	.06
Labor on forms and runways	890.61	.52
Blacksmith	137.19	.08
Finishing	373.02	.22
Miscellaneous labor	611.74	.36
Administration	878.25	.51
Engineering	633.07	.37
	$15,531.10	$9.07

HEADWORKS—WEIRS.

The parts of the headworks of a gravity irrigation system usually consist of diversion weir, canal headgates, scouring sluices and spillway or wasteway, and in some cases a fish ladder and logway.

The main object of a diversion weir is to raise the level of the water in the river when the supply is low and force it to flow through the headgates of the canal. A diversion weir is not always necessary. It may be more economical to continue the diversion line to a point where it will take the water at stream level. This usually requires a minimum flow in the river in excess of the desired canal supply.

The height of weir for any definite site depends on the depth of water in the canal, on the elevation of the floor of the canal and on the effect on lands above the weir. A high weir may, especially during the flood flow, cause either an overflowing of the river and damage land above the weir, or may change the channel of the river. This may be prevented by training or protection works to confine the river in its channel, or may require an open weir or a low weir with collapsable crest to allow flood flow to pass on with the least obstruction.

The length of weir depends upon velocity and volume of stream flow. Where a stream has high velocity and large flood flow, if several weir sites are available, it may be advisable to select the site where the length is not too small, for a short weir would necessitate a much heavier and stronger section than a weir of greater length. The decreased cost of the lighter section may offset the increased cost of a longer weir. A short weir requires a greater depth of water on the crest, which may cause the overflowing of land upstream, and is also subject to greater forces.

On the other hand, where a stream has a slow velocity and carries considerable sand and silt, it is preferable to restrict the weir to as short a length as feasible in order to obtain a higher velocity and prevent the deposition of silt, which in some cases may form islands above the weir. These islands may cause considerable trouble in diverting the channel of the river from the headgates. As a rule it is preferable to use the weir site giving the shortest weir.

The position of weir is generally at right angles to direction of flow. A skew weir has a tendency to cause currents parallel to the weir axis, which, on soft foundation, may result disastrously. A skew weir should only be used on very firm foundation.

Location of Weir.

A. Determination of location.

1. By topographical survey of entire country, using, when available, the U. S. G. S. maps.

2. By leveling from highest point of land to be irrigated, allowing proper grade for necessary length of canal, till the grade line intersects the stream or point of diversion.

3. By leveling from suitable point on stream to highest point of land to be irrigated, introducing drops or falls for excessive grade.

B. Conditions favorable to a good site for headworks.

When several sites are available the most favorable is that:—

1. Where there is room for construction of canal headgates and diversion line without the necessity of expensive construction, such as tunnel work, retaining walls, deep cut, etc.

2. Where the canal headgates can be placed at right angles to weir so as to keep a clear channel in front of the gates.

3. Near suitable building material.

4. Where good foundation and permanent banks can be obtained.

5. Where impervious stratum is at or near surface.

6. Where slope of stream is steep enough so that canal and stream shall be at the same level only for a short distance.

7. Where expensive high dam will not be needed to divert the water. It may be more economical to construct longer diversion line.

8. Where construction of weir will not cause flooding of lands above or tend to change the stream channel.

9. Where an escape can be constructed for scouring out material accumulating in upper part of canal.

10. Where velocity in stream shall be preferably less than the velocity in the canal which is desirable to prevent silt deposits in the canals. This can be largely regulated by the design of headgates.

11. Where channel is straight with uniform velocity and regular cross section. If on curved channel, when velocity is small, place headgate on outside of curve; when velocity is great, place on inside of curve where it will be safe from erosion. This especially applies to sites where no diversion weir is necessary.

C. Types of location.

The location of a weir site will be at one of the following points on the stream:

1. Junction of plains and foothill.
2. In plain or valley.
3. In the hills.

(1). When the weir is located on the stream where it emerges from the hills, at the junction of plains and foothill, the following conditions are generally encountered. The surface topography will be fairly smooth, the soil firm, and there will be few drainage crossings. These conditions would be favorable to an inexpensive diversion line. The sub-surface will usually be satisfactory for good foundations. It generally consists of gravel and boulders which in some cases overlay solid rock.

(2). When the weir site is on the valley portion of the stream the surface topography is usually smooth and fairly level and the stream has a flat grade. The sub-surface conditions are usually a stream bed of sand or clay; when sand and gravel it is necessary to prevent underflow under the dam. The conditions are favorable to a short and inexpensive line and to a low but long diversion weir. The disadvantages are (a) that the stream may not have sufficient fall to permit an easy diversion, (b) that there is danger of submerging land above the weir and of the stream cutting a new channel, (c) on streams with wide sandy beds, islands tend to form above weir and may cause parallel currents. These effects are largely prevented by using either an open weir on a closed weir with removable crest.

(3). When the weir site is in the hills the surface topography is rough, the slopes of side hills are steep, and the grade of the river large. The sub-surface conditions are generally a solid rock or boulder stream bed. These conditions usually require a strong weir in a narrow gorge and difficult and expensive construction of headworks and diversion line, with frequent cross drainage works, flumes, siphons, culverts, etc.

Causes of Failures.

The failures of weirs are generally due to one or more of the following causes:

A. Breaching by force of current.
 1. Impact of falling water on floor of weirs which have a vertical drop.
 2. Impact of trees and ice.
 3. Erosion or scouring of downstream face of weir.
 4. Erosion of river bed below weir and undermining.

B. Blowing up of weir by upward pressure on the under side of the impervious downstream floor.

C. Undermining of foundation by underflow.

D. Outflanking, especially where banks are friable and stream not straight. May be prevented by training works.

E. Parallel currents on upstream side of weir caused by islands formed above weir or caused by the weir being built on an angle with the direction of flow. To prevent formation of islands and the rise of the bed of the river caused by advancing sand, gravel or boulders, restrict length of weir, use open weir or provide collapsable shutters on closed weir. To prevent parallel currents on wide streams, buttresses or groins can be built at right angles to weir.

Diversion Weir, Modesto-Turlock Irrigation System.

NEW TELEPHONE SERVICE FOR CHINESE PORT.

The project of establishing a telephone system in Swatow, is again actively engaging the attention of local capitalists.

It is planned to open with a small exchange of about 100 subscribers, and it is not expected that there will be over 250 subscribers altogether in Swatow at any time. The concession was granted last October, and certain English and German manufacturers sent agents to study local conditions and submit estimates.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Put it up to the Regulating Commissions

The telephone utility, a child of this generation, has so interwoven itself with the needs and daily life of the human race, argue against its ultimate good effect upon mankind if you will, nevertheless it is here to stay. Who knows but that Gabriel's last trump may be sounded by wireless telephony—so universal may be the ultimate application of this utility.

Incident in the affairs of life many unwarranted attacks are at times made upon those wholly blameless to the charges preferred. Wander at random, however in the cities of the West and perchance endeavor to use the telephone. In some cities immediate service is the result, while in others one can scarcely refrain from notes of plaintive memory: "I've waited, central, waited long for you." Again, in certain cities telephone rates appear from the surface absolutely incommensurate with the service rendered. Not only is this true, but the segregated parts of the charges certainly make up an inharmonious whole, difficult of explanation, at least to the layman's reasoning powers.

Take, for instance, the intercommunicating system, furnished by the Bell Telephone Company to its patrons. Here is a simple piece of apparatus, which any clear-thinking mechanic will tell you can be manufactured in bulk for a couple of dollars apiece, yet the patron is asked to pay annually six dollars for the box and six dollars for the telephone extension. It cannot be argued that this additional equipment causes unpaid for annoyance or extra work in operation of the main lines, for the company again provides an additional charge for calls over and above a minimum allowance. It is generally known in business circles that the executives of one of the largest jobbing houses on the coast recently desired to install this system in their new quarters for their own private use, but upon being told that they could not purchase an outfit for even $10,000 and that the annual rental would be $600 per year, went to an independent competitor and satisfied their wants by purchasing a complete equipment for $500.

Such wanton acts as this mildewing in the public mind, make the path of the utility company anything but a bed of roses, even though that company is endeavoring to be square and upright as a whole. Why, then, should the sore canker longer? If the telephone service is below par as thousands of citizens say it is, then an immediate remedy should be demanded? If the public is being held up unjustly in the charges forced upon them, or if any one of these charges bear an undue weight to the whole as is asserted on all sides, surely the regulating commissions have the authority and should use their strong right arm in adjusting the matter for all time to come. On the other hand, if these charges are not true the utility company should receive the cordial support and commendation of enlightened public sentiment, thereby acquired.

No one can meet the executives of the great telephone company on the coast without becoming impressed with their clean, clear cut mannerisms. Among their engineering staff are to be found men not only of intensified technical attainment but men of the highest ethical standing. Some eminent authorities have

argued that the human race is possessed of two consciences—the individual and the mob, that although separately an act would not be done, yet collectively the mob conscience becomes hardened. Such a belief is indeed the blackest and most deadening philosophy that one can entertain. Here, however, is a wide sweeping cry raised by the people on one hand, pittted in angry defamation against a group of honorable, highly sensitive business men, operating what may now be termed a human necessity. If all parties to this issue do want to do the square and upright thing, which as individuals no one doubts, but that they would do, then let them show down. Let them not only in a passive manner suffer impartial investigation and adjustment, but let them actually satisfy the public of their sincerity by openly courting such procedure.

Accidents, the How and Why

The past year, when reviewed in memory's fast fading shadows, stands ghost-like in its warning to inventory takers at this season of the year. The Titanic and its horrors beckon to the executive heads of transportation companies and others who have the directing of gigantic tasks wherein human lives are at stake, that they reckon not alone the physical inventory which leads to the determination of dividends and profits but also call a full stop and cast a balance sheet to determine the possible accidents that may occur and methods of their prevention. Especially should those directing Western enterprises heed this cry from the past.

Review for a moment some of the horrifying accidents of recent years. The General Slocum on the Hudson was heart-rending in its closing scenes, the Titanic and even the Rio de Janeiro attempting to enter the Golden Gate, were but typical scenes that might have happened to hundreds of other ships provided the combination of circumstances equally formidable presented themselves. But the next day—ah the next day—as the Good Book states: "Even the fool is wise after the event." Bearing in mind these awful catastrophes of the past, would it not be better to do away with some of the "I-told-you-so" talk and get busy in ferreting out possible chances that are perhaps even now being undertaken unawares in Western enterprises.

The spirit of the day in engineering is to step the voltage up to loftier limits, to build the dam to sublimer heights to concentrate more power in smaller shells and above all to outdo the competitor in his efforts. There is something inborn in us all, which calls for sincere admiration for this spirit of the West —that spirit which leads men to do and to dare, and above all to make good. Engineering enterprises, however, like the well-known laws governing materials of construction, have their elastic limit, beyond which a permanent set is bound to occur and disaster follow. True it is that brains and imagination may extend this limit from time to time but in the extension of this working range, we should build and build well or beware the crash.

Dangers often exist around us but the all necessary combination of circumstances, due to the low probability of occurrence of the individual events making up the whole, is so great its delay in coming is deceptive. Simply because, in throwing dice, the ace does not show itself in three trys is no argument that a one spot will not come in due time. Indeed, severe mathematical proof has established with certainty that, although one may throw three dice, in an endeavor to make an ace appear on each one, and fail two hundred and fifteen times, yet in the long run this will occur every two hundred and sixteen throws. So positive is the law of chance, mathematicians have established the ratio of the diameter of a circle to its circumference simply by counting the number of times straws would by chance drop through a grilled circle after a long series of trials.

It behooves all, then, to look well to the seldom but sure appearing of a combination of circumstances leading to disaster. The citing of but one instance will suffice. In the metropolitan district of Central California, thousands of commuters travel each day back and forth on ferry boats and electrified interurbans designed in accordance with the best and last word from invention. Certain of these boats have become so heavily patronized that between the hours of five and six, more passengers are taken than seats will accommodate. The seldom happening event is here possible to occur —the sudden bump, the excited crowd with no room to move to the decks or outer portions, the heart-rending shudder, the awful gurgling seconds immediately follows, and the floundering, helpless cries. Oh horrors —in such catastrophe—a passenger would have as much chance as a five ampere fuse wire short-circuiting a hundred thousand volt transmission line.

Now is the time for enlightened public sentiment combined with the best available engineering skill to check up such possibilities as these, which illustrates only one of the many that may perchance occur in the busy West.

Condensers for Lightning Protection

In the installation of lightning protective equipment it must be admitted that by doing away with the spark gap installation the consequent high series resistance in the ground connection becomes at once unnecessary. A non-inductive direct connection to ground cannot, however, be made on a high tension alternating current overhead transmission line without disastrous results. On the other hand a path to ground may be provided either through a highly inductive choke coil, or through a condenser, or through both. The inductive resistance may be easily designed to pass only inappreciable current of the normal or higher frequency, and it will therefore be useless as a means of relieving the line of a static charge. The condenser, however, acts as an almost perfect insulator so far as direct currents are concerned; but it is pervious to high frequency currents. A suitably designed condenser, or battery of condensers connecting between line and ground without the intervention of any spark gap is ideal in its handling of very high frequency oscillations that accompany lightning phenomena. The possible advantages of using condensers, provided the cost of these is not prohibitive far outbalance the objections. Such installations have apparently met with much favor in other parts of the globe, and there seems no reason why they should not prove equally effective on this continent and especially in the West.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

S. K. Colby, vice-president Pierson-Roeding Company, left this week for an extended trip east.

F. S. Hurst, of Pierson-Roeding & Company, recently returned from the south, where he went to spend the holidays.

H. L. Aller has succeeded **R. C. Whitmarsh**, resigned, as manager of the Pacific Gas & Electric Company at Phoenix, Ariz.

Herbert Haas, mechanical engineer, presented a paper on the Diesel engine at the meeting of the San Francisco Engineers' Club on January 7th.

H. S. Clark, Pacific Coast representative of Westinghouse, Church, Kerr Company, left last Saturday for an extended trip throughout the north and east.

G. B. Harrington, assistant general superintendent of the Puget Sound Traction, Power & Light Company, has returned to Seattle, after spending a month in the east.

J. A. Vandegrift, manager of the Oakland warehouse, National Quality Division of the General Electric Company, left during the past week for a trip throughout the East.

F. W. Hild, general manager of the Portland Railway, Light & Power Company, of Portland, Ore., is at Los Angeles and expects to be in San Francisco again January 16.

N. W. Brockett, secretary of the Northwestern Electric Light & Power Association, has sent out notices that the next meeting of the association will be held at Seattle, Wash., September 10, 11, 12, 1913.

Russ Holabird, of the Holabird-Reynolds Company, expects to leave the latter part of the week for the east, visiting his New England agencies, Chicago and other eastern cities, returning home about the first part of February.

J. R. Townsend of Portland, manufacturer of the Townsend pole top switch and representative of the Lord Manufacturing Company, the Electrical Engineers Equipment Company, and Stave arc lamps, is visiting San Francisco.

P. T. Hanscom has become assistant to the president of the Great Western Power Company, his duties as general superintendent being assigned to **E. W. Beardsley**, who has acted in a similar capacity for the Oakland, Antioch & Eastern Railway.

S. B. Charters Jr., assistant professor of electrical engineering at Stanford University, and at one time chairman of the San Francisco Section A. I. E. E., died on December 29th at Pittsburgh, Pa. All who have been associated with Professor Charters in the past will deeply feel the passing of his kindly personality.

A. E. Barlow, general sales manager for the American Ever Ready Company, called a Pacific Coast sales meeting at San Francisco this week. Those in attendance included **Roy Worth, C. E. Johnson, A. G. Bowes**, and **G. A. Koch** of the San Francisco office, **F. W. Kitson** of Spokane, **J. W. Leighton** and **R. R. Ruddiman** of Seattle, **F. T. Chapman** of Portland and **U. S. Johnson, C. T. Turner**, and **R. H. Marshall** of Los Angeles.

W. N. Ryerson, chairman of the Hydroelectric and Transmission Section of the National Electric Light Association, has appointed a number of Pacific members, including **P. M. Downing** of the Pacific Gas & Electric Company at San Francisco, who will act as chairman of the committee on distributing lines; the other Western members being **Markham Cheever** of Utah and **J. A. Lighthipe** of Los Angeles and **E. A. West** of Portland, and **C. L. Cory** of San Francisco, on the committee on receiving apparatus.

R. H. Ober was elected president of the Pacific Northwest Society of Engineers at the annual meeting held at Seattle on January 4. **Marvin Chase** was elected first vice-president; **Joseph Jacobs**, second vice-president; **Sterling B. Hill**, third vice-president; **Jesse A. Jackson**, secretary; **W. N. Chase**, treasurer, and **C. E. Hill**, librarian. Addresses were made by Superior Judge R. B. Albertson on the "Expert Witness." G. R. Conway of Vancouver, B. C., chief engineer and acting manager of the B. C. Railway Company, on "The Influence of Architecture on Modern Engineering"; Samuel Hill on "Good Roads," and Capt. Powell, the retiring president. The society now has a membership of 221.

J. G. WHITE & COMPANY'S RE-ORGANIZATION.

J. G. White & Company, Inc., of New York City, who for the past four years have maintained an office in San Francisco, announce the consummation of their plan to organize their engineering and construction and management departments into separate corporations.

Henry A. Lardner, who has been manager of the San Francisco office of the company, becomes a vice-president of the engineering corporation, but will continue his residence here in charge of Pacific Coast affairs. and Charles F. Conn, who has for some years been associated with the New York and San Francisco offices, will also remain in San Francisco.

The officers of the J. G. White Engineering Corporation are as follows: J. G. White, chairman finance committee; Gano Dunn, president; E. G. Williams, vice-president; A. S. Crane, vice-president; H. A. Lardner, vice-president; H. S. Collette, secretary; R. B. Marchant, treasurer.

Among the prominent California projects with which J. G. White & Company has been identified are: The construction of the Oakland & Antioch Railway and its associate, the Oakland, Antioch & Eastern Railway, now building between Oakland and Sacramento, a distance of 84 miles; the construction of a natural gas pipe line, 124 miles long and 12 inches in diameter, for the Midway Gas Company, which line is noteworthy because of its length and because it is to operate at a pressure of 450 pounds per square inch, the highest yet employed; the design and construction of storage reservoir and power plants, both hydraulic and steam, for the San Joaquin Light & Power Corporation, including the new 5000 h.p. development on the Tule River. Hydroelectric developments with which this company has been identified in other sections of the country include: Those on Big Sandy River, in Oregon; the Deerfield, an important tributary of the Connecticut River; the Savannah, near Augusta, Georgia; the Broad, near Columbia, South Carolina; the Ocoee, in the mountains of Eastern Tennessee, and the St. Lawrence, near Montreal, Canada. The aggregate capacity of these water powers is approximately 366,000 horsepower.

The J. G. White Management Corporation announce as officers: J. H. Pardee, president; F. H. Reed, vice-president; S. L. Selden, vice-president; T. W. Moffatt, secretary and treasurer.

The business of the Management Company was established some years ago as a department to supervise the operation of properties in which J. G. White & Company, Inc., was interested. This department, which has now been incorporated into a separate company, was, on December 31, 1912, acting as operating or consulting manager of public utility and railroad properties in the United States, Nicaragua, and the Philippine Islands.

The parent organization of J. G. White & Company, Incorporated, controls the new companies and will continue as an active financing and owning company.

COOPERATION BETWEEN THE PORTLAND RAILWAY, LIGHT & POWER CO. AND THE CITY INSPECTION DEPARTMENT.

In the future, all new electrical work in the city of Portland must be passed by the city electrical department before the Portland Railway, Light & Power Company, will supply service to same.

All orders the company receives for service are reported to the city department, who checks same over and passes or approves same for service. This is a great assistance to the city department and also insures better service for the consumers of electrical energy.

To further the interests of all parties concerned all the inspection departments (underwriters', city, and power company's) meet every two weeks and talk over all points of difference and settle upon methods of bettering conditions electrical. "Co-operation" is the motto and great results are accomplished.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Dec. 28.

The Torrance Water, Light & Power Company of Torrance, Los Angeles County, applied to the Railroad Commission for authority to issue 200,000 shares of capital stock (par value $1) for construction purposes.

The Great Western Power Company withdrew its application of December 23 and filed a complaint that the Pacific Gas & Electric Company and the Pacific Telephone & Telegraph Company be compelled to allow the Great Western Power Company to use their poles in Suisun upon the payment of a proportionate cost. The town of Suisun joined in the complaint.

The Southern Sierras Power Company applied for authority to raise certain rates for electric power service for pumping for irrigation purposes in portions of Riverside and San Bernardino counties.

A decision was rendered denying the application of the Roseville Home Telephone Company, of Roseville, Placer county, to raise the rental charge on farmers' lines from 25 cents to 50 cents per month.

A decision was rendered granting permission to the Southwestern Home Telephone Company, of Redlands, to advance the monthly charge for telephone service from San Jacinto to Winchester, Riverside county, from $1 to $1.50 per month.

A decision was rendered granting permission to the Coast Counties Gas & Electric Company to purchase the property of the Gilroy Gas Works for $25,000.

A decision was rendered denying the application of the Eel River & Southern Telephone Company, of Ferndale, Humboldt county, to establish a new schedule of rates.

A decision was rendered granting the application of W. H. Hoffett & Son, of Lemon Cove, to increase the rate on its Lemon Cove telephone lines to 50 cents per month.

A decision was rendered denying the application of the Raymond Telephone Company, of Raymond, Madera county, to increase rates between Raymond and The Pines, via Coarse Gold and Fresno Flats. The commission found the accounts of the company intermingled with those of a mercantile enterprise and directed that the telephone company segregate its accounts so as to present a proper financial statement within six months.

Dec. 31.

The San Diego Consolidated Gas & Electric Company applied for permission to issue $500,000 of six per cent debenture bonds.

A decision was rendered in the case of the town of Willits vs. the Willits Water & Power Company. The commission upheld the contentions of the city of Willits in its complaint of discriminatory rates in favor of big consumers and against the general public. An order was issued establishing a general decrease of 12 per cent for individual domestic consumers and certain increase for large consumers.

A decision was rendered granting permission to E. W. Crosby, doing business under the name of the Reedley Telephone Company, to establish a farmers' line rate of $3.60 per year as against a former rate of $3. The company was denied authority to raise its exchange rates.

A decision was rendered granting permission to the City Electric Company of San Francisco to issue $833,000 of bonds to be used as collateral security for loans to be made by the corporation.

Jan. 2.

A decision was rendered granting the application for a transfer of a franchise from Russel-Robison to the Russel-Robison Water & Electric Company, of Arroyo Grande, San Luis Obispo county.

A decision was rendered reducing the maximum lighting rates of the Northern California Power Company from 10 cents per kilowatt hour to 7 cents, or approximately 30 per cent in Colusa and Glenn counties; from 9 cents to 7 cents, or 22 per cent in Shasta and Tehama counties; from 8 cents to 7 cents, or about 12½ per cent, in Butte county. The reductions become effective on January 10. The decision also calls for a material reduction in power rates throughout the northern part of the state.

The Oro Electric Corporation applied for a certificate of public convenience and necessity to enter and serve the city of Stockton.

The Pacific Electric Company applied or authority to issue refunding mortgage 50-year gold bonds in the sum of $7,034,000. The proceeds will be devoted to improvements covering the principal lines of the company in Southern California and to the construction of new lines in the southern part of the state.

OREGON TECHNICAL CLUB.

The Oregon Society of Engineers and Portland Architectural Club have united their organizations in a parent association, styled the Oregon Technical Club. The purpose of this procedure is to afford a means by which club quarters may be maintained for all members of technical and professional societies that have obtained membership in the parent association. A Board of Governors, elected from each membership constitute the officers and manage the affairs of the club. Those elected to serve the first term are: J. A. Fouilhaux, Frank Logan, W. D. Holford, Paul Schuchart, H. L. Vorse.

BOOK REVIEW.

Elements of Western Water Law. By A. E. Chandler: size 6x9 in.; 150 pages; cloth binding. Published by the Technical Publishing Company of San Francisco, and for sale at the Technical Book Shop, 106 Rialto Building, San Francisco. Price $2.00.

The writings of Professor Chandler need little introduction to the readers of the Journal of Electricity, Power & Gas. This book is a compilation of a remarkable series of articles on western water rights which appeared in the columns of the Journal during 1912. Mr. Chandler, the well-known irrigation and water right specialist, has produced within the covers of this book, a compendium of western water rights, written in the clear, concise language of the polished engineer, and given to his profession, a hand book of information indispensable to Western engineers. The author covers in logical procedure a treatment of water right procedure in all the Western states, calling attention to good and bad features in vogue in the various commonwealths. The concluding chapter, being a desideratum in legislation regarding the public waters, is a splendid equipment for the practicing engineer. A thorough index is appended wherein is found alphabetically recorded subjects relative to water right procedure for the different states of the West.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

COSTS AND EFFICIENCY.[1]

BY P. L. PROCTER.

The pleasure derived from meeting men depends greatly on the class of men met. When I sum up the achievements of the electrical contractors I cannot but feel that the pleasure is "all mine." Civilizers of the civilized is a term which I think is adaptable to you, for you represent a profession which, although remarkable at the present time, is yet, as we are told, in its infancy.

The subject I have taken for my address is one with which you are more or less familiar, but it is my purpose to explain to you details from an accountant's view. I shall endeavor to confine my theories so as to make them applicable specifically to the needs of the electrical contractor. It is well to forget, however, at this time that "The electrical contractors' business is different." While the details may change, the principles of costs and efficiency remain the same, no matter to which business they are applied.

The principles of costs as related to the electrical contractor, or any other contractor, are material, time, direct expense and indirect expense. The total of these plus profit is the amount a contractor must estimate in order to assure himself of his legitimate profit.

In order to arrive at a complete understanding of a business, introduce a scheme of accounts for ascertaining and recording the cost of production, locate all weak places and so detect waste of material, efficient workmanship and management. Indicate the expediency of underbidding a competitor by comparing the cost of production with his bid; establish a standard cost on certain jobs; expedite the framing of estimates to prevent loss by making low quotations, or unnecessary high ones, which will permit a competitor to underbid; regulate bidding price according to cost, when conditions of supply and demand permit. These features must necessarily be embraced in a cost system to be beneficial.

Now let us examine such a scheme to see in what way it would benefit you.

(1)—Where external conditions permit you will be able to adjust bidding price on the basis of costs.

Many a contractor feels that he is ruining his business by not grasping every job that comes along. He never stops to consider where his profit is to be realized, but the sight of a few dollars, or the anticipation, goes to his head. Business conducted in this manner results in the inevitable transfer to the "has been" list. The unbusinesslike principles of this one man does not only affect him as an individual, but it affects the whole trade as a body. Profit can be made on all work, but if one contractor makes a practice of underbidding, the consequences are that other contractors must patiently wait until the bankruptcy law begins to stretch out its arms for him. If "John Smith" makes an estimate on a job which you know you cannot compete with, you had better let him take it. Either he will go out of business or your own business needs rigid investigation.

(2)—It automatically locates weak places and points out excessive cost.

A feature which is indispensable. There are weak places in every business, and the only way to eliminate these weak points is by first assuring yourself in what department they prevail and in what unit of that department.

(3)—It furnishes a basis of comparing costs of various elements at different periods of time, indicating excessive increase of cost or decrease in output.

[1]Address delivered before the Convention of Oregon Electrical Contractors' Association by Manager of the Pacific Audit Company, December 17, 1912.

Knowledge of a business is attained by comparison. The fact that you had lost money on an estimate, but made money on a prior duplicate of it is sufficient grounds for an investigation. The investigation must be a comparative one. The material used on the subsequent estimate may have been more expensive, the labor employed may not be as efficient, the management may be at fault, but by the introduction of a comparative cost scheme these elements would be obvious before an estimate is made, and not when it is too late.

(4)—Shows the exact point where attention should be focused.

(5)—Where external conditions fix estimates you will know exact cost of production and be able to secure advantageous contracts which may otherwise go to a competitor.

It is often necessary for a contractor to reduce his estimate to the minimum because of external conditions over which he has no control. It is also often necessary, or considered business policy, for a contractor to reduce his estimate practically to cost of production in order to become acquainted with various architects with the idea that it may in some future time secure for him advantageous contracts. It is essential at such a time for him to know where the line of danger lies, and to know definitely his cost of production.

(6)—It determines the earning capacity of individuals, departments, branches or entire organizations.

By the old methods of accounting it was possible only to determine at stock-taking the amount of profit or loss of the entire organization. Competition makes it necessary for the business man of today to go further than this. The public designates the price for a certain class of work, and this has forced the business man to look elsewhere for profit. The only available place is the cost of production. It is essential, then, that he know the relative earning capacity of his men as individuals or the departments of his business.

(7)—It indicates the expediency of underbidding any competitor.

I have before mentioned that the contractor must know where to draw the line in underbidding, and not rush headlong into any contract. Money has strong hypnotic powers, and unless a business man uses his discretion he is gradually drawn into the maelstrom of failure by it. A man who has no system to his business usually is also devoid of discretion.

(8)—It furnishes a basis of protection from undue expense or loss from any source.

This is again brought about by comparison. "Undue expense" may be inefficiency in workmen, careless work, which necessitates it being done over again. This may be traced to the foreman, who has urged too much speed. This may again be traced to the executive who has given such instructions to the foreman. Low estimates often make it necessary for an executive to urge his men to better speed in order to avert a loss for which he alone is responsible. It will be seen that it is possible to trace the trouble to its foundation, therefore overcoming the most difficult obstacle in the way of eliminating it.

(9)—It shows how and when to reduce unnecessary fixed charges, such as time, material, men, records, interruptions, overtime, handling, etc.

In order to facilitate arriving at the costs on any job, particular attention should be paid to the manner of recording estimates. An estimate should be divided into departments in exactly the same manner that the cost records record the progress of a job by departments

(To be continued.)

NEWS NOTES

INCORPORATIONS.

SPOKANE, WASH.—Inland Independent Telephone System; $15,000; L. B. Cornell, Geo. R. Boomer.

ILLUMINATION.

BERKELEY, CAL.—The Pacific Gas & Electric Company will soon lay gas mains in Thousand Oaks.

SELIGMAN, ARIZ.—The Santa Fe Company plans to install an electric light plant here at a cost of $7550.

HERMISTON, ORE.—The Hermiston Light & Power Company has been granted a franchise to furnish lights for Echo.

YUBA CITY, CAL.—The election to organize a lighting district for the town of Live Oak carried, the vote being about two to one in favor of the same.

CHINO, CAL.—The Southern California Edison Company has been granted a franchise to construct and maintain a gas system in the public streets of Chino.

WELLS, NEV.—H. H. Cazier and his father, John H. Cazier, have been granted their application to appropriate the waters of Trout Creek for power purposes.

LOS ANGELES, CAL.—The installation of a system for street lighting in Garden district is recommended by H. R. Manahan, city electrician, in a report to the board of public works.

STOCKTON, CAL.—The Oro Electric Corporation has applied to the Railroad Commission or a certificate of public convenience and necessity to enter and serve the city of Stockton.

ELSINORE, CAL.—The Southern Sierra Power Company has applied for a 50-year franchise for transmitting electrical power in all public streets, said franchise will be sold February 10.

YREKA, CAL.—The California-Oregon Power Company is canvassing the rancher's living between its substation in Scott Valley and Callahan, a distance of 14 miles, to see if enough subscribers to take light and power can be secured to justify the building of a line.

ASTORIA, ORE.—Plans are being made by the Pacific Power & Light Company to reconstruct its gas plant in this city. The pipes are to be changed over and new purifying apparatus, new boilers, scrubbers and wash boxes will be installed.

PORTLAND, ORE.—The city executive board has adopted a resolution granting the petitions of property owners for street lights in all sections of the city. They will be installed by the Portland Railway, Light & Power Company, which will be paid a rental of $56 a year for each light, in accordance with the provisions of its present contract with the city.

SACRAMENTO, CAL.—A decision has been handed down by the Railroad Commission making a substantial cut in the rates charged by the Northern California Power Company. This decision follows closely upon the action recently taken by the commission which resulted in general reductions in lighting rates throughout Southern California. By the terms of its ruling in the Northern California Power case the commission reduces the maximum lighting rate in Colusa and Glenn counties from 10c per kw.-hr. to 7c, or approximately 30 per cent; from 9c to 7c, or 22 per cent in Shasta and Tehama counties, and from 8c to 7c, or about 12½ per cent, in Butte county.

STOCKTON, CAL.—At the meeting of the City Council only one bid, that of the Western States Gas & Electric Company, was received for street lighting during 1913, and the contract was awarded to that company. Arc lights will be furnished at $6 per light per month, to burn on an all-night schedule, and for electroliers the all-night schedule for five lamps will be $40 per year per electrolier. For five lights till midnight and one from midnight till day the rate will be $25 per year. Both electrolier prices are with the understanding that the company will not provide for their maintenance or for new lights and globes. The company will accept that work for $10 per year per lamp additional.

TRANSMISSION.

CORVALLIS, ORE.—The Oregon Electric Railway Company will build a branch from the main line to this city. Work will be started shortly.

VICTORIA, B. C.—Residents of Sydney have petitioned the British Columbia Electric Railway Company to extend their system to that city.

SEATTLE, WASH.—All bids submitted for furnishing 12 cars for the municipal railway and electrical equipment for same have been rejected as too high. Same will be re-advertised at once.

BEND, ORE.—The Central Oregon Power Company has been granted a franchise to construct power lines along the highways of Crook county. Kempster B. Miller was also granted permission to string telephone wires.

HOOD RIVER, ORE.—Construction of a 7000 h.p. hydroelectric plant intended eventually to supply power to operate an electric railway through Hood River valley will be started here by the Pacific Power & Light Company, the first of the year.

MOUNT VERNON, WASH.—The Stone & Webster Engineering Corporation is remodeling the old Mt. Vernon Interurban Railway Company's building on Main street, converting the same into a depot. Plastering, partitions, etc., are included in improvements.

TACOMA, WASH.—President John A. Shackleford of the Tacoma Railway & Power Company, is authority for the statement that the company will apply for a franchise to operate across the new Eleventh street bridge to tidelands, the mill and factory district of the city.

PORTLAND, ORE.—If deal for property located in Albina avenue, between River and Loring streets, being negotiated by the Northwestern Electric Company is consummated satisfactorily, a concrete or brick auxiliary power station will be built by the company at the location named.

HOOD RIVER, ORE.—Announcement has been made by officials of the Pacific Power & Light Company that Hood River will have the largest electric power plant in the state. The proposed plant to be built will develop between 7000 and 8000 h.p. It is also reported that the Pacific Power & Light Company will take over the Hydroelectric Company here.

LOS ANGELES, CAL.—The Southern California Edison Company, the Pacific Light & Power Corporation, and the Los Angeles Gas & Electric Company, have offered to take over power developed from the aqueduct from 35,000 h.p. upward, and have offered $1,000,000 per year for water power. The Council and Public Service Commissioners have the matter under consideration.

CENTRALIA, WASH.—To generate power from the falls on Coal Creek, eight miles west of Kelso, and to use the same in the operation of pumping plants within the Mount Solo diking district, is the plan of the commissioner of diking district No. 1. Steps have already been taken toward the locating of a power site on the river, and the commissioners expect to begin generating electric power as soon as possible.

VANCOUVER, WASH.—The Northwestern Electric Company has asked for a franchise to supply light, power and street car service in this city. The company asks for a 50-year franchise. The proposition was laid over until the next meeting of the city council.

RENO, NEV.—The Nevada Valley Power Company having a power site on the Truckee River at the Largamarsino bridge, and having other power sites in the mountains near Reno, has filed a $3,000,000 trust deed with the county recorder here, intending to bond its property for this amount to secure money to build its power plants. It intends to run in competition with the Truckee River General Electric Company. The company, in addition to its power sites, owns land and a number of rights of way. The trustee for this company is the International Trust Company of Denver. The directors are: H. D. Danforth, a local attorney; Edson Adams, Edward Bowes, Milton Hamilton and A. F. Tarley, all of Oakland.

REDDING, CAL.—The Redding Land Office has received notice that by an executive order of December 1 the government withdrew from entry 559 acres on McCloud River and 3038 on the Sacramento north of Copley, and reserved the acreage, "for water power sites, as Power Site Reserves No, 324 and No. 325." respectively, subject to the limitations, provisions, exemptions and conditions contained in the Act of Congress, approved June 25, 1910. The notice is accompanied by a detailed description of the land by sub-divisions. The land withdrawn includes every possible power site on the Sacramento from Conley north to Cantara, between Dunsmuir and Sisson. On the McCloud the sites withdrawn lie directly east of Sims and Antler, respectively. One site withdrawn is on Squaw Creek, a tributary of the McCloud.

REDDING, CAL.—The Northern California Power Company will spend $225,000 in Shasta county this year on improvements and betterments. The construction outlined is building the Dry Burney Creek storage reservoir, the greatest conservation project in the State, doubling the capacity of the power plant at Kilarc, or increasing it from 4000 to 8000 h.p., and doubling the power output of the South Cow Creek power plant. The Dry Burney Creek reservoir and 8250 foot tunnel in connection therewith will cost $130,000, as nearly as can be estimated. The enlargement of the Kilarc plant will cost $35,000, and the enlargement on South Cow Creek will cost the rest of the money appropriated. The Dry Burney Creek storage reservoir will be three and a half miles long and two and a half miles wide, with a shore line of nine miles. The average depth of the water will be 19 ft. The reservoir will hold 30,000 acre-feet of water—nearly a billion gallons—and after it has been utilized fo rgenerating power it will be available for irrigating 10,000 acres of Cow Creek Valley, as fertile land as lies within Shasta county's borders.

TRANSPORTATION.

SACRAMENTO, CAL.—The officials of the Central California Traction Company have moved the general offices of the company to Stockton.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has awarded the contract for furnishing 65 city cars to cost approximately $500,000, to the Preston Car & Coach Company, Preston, Ontario.

TACOMA, WASH.—The Hillside Improvement Club has appointed a committee to confer with officials of the Tacoma Railway & Power Company relative to establishing a car line up Seventeenth street as far as Sprague.

EUGENE, ORE.—Plans for a new depot to be built here by the Oregon Electric Railway Company may be seen at the office of M. J. Duryea, Eugene Commercial Club. It is understood bids for material and construction will be received shortly.

TILLAMOOK, ORE.—It is rumored here that the United Railway Company will build an electric line from Banks to this place. The purchase of a 22,000 acre timber tract by the Tillamook Timber & Logging Company necessitates the proposed improvement.

EDMONTON, ALTA.—Inspector Moir's plan to build a belt system of 110 miles of electric railway lines in this city has been adopted by the city council. About 220 cars will be required. Commissioner Chalmers announces that at least 18 miles of track will be laid in 1913.

SEATTLE, WASH.—The following plans and specifications for materials to be used in the construction of the city municipal railway have been filed with the Board of Public Works. The switchboard and apparatus for the substation, motor generator set, two 500 kw. poles, stubs, etc.

SANTA BARBARA, CAL.—J. C. Breckenridge of Brooklyn, N. Y., who is to rebuild the Santa Barbara street railway system, has arrived in the city and it is expected that plans for construction will be decided upon at once. Mr. Breckenridge was manager and chief engineer for the Brooklyn Rapid Transit Company, and he will devote his entire attention to the reconstruction of this system.

OAKLAND, CAL.—Permission has been granted the San Francisco-Oakland Terminal Railway by the City Council to run a construction line on a private right of way between Forty-first and Forty-second streets, from the Key Route pier to the proposed tunnel on the road to San Jose. The line will be used for the hauling of rock and dirt from the excavation to the pier, which is to be made into a solid fill.

EL PASO, TEXAS.—The Rio Grande Valley Traction Company, which is the name of the new interurban line, will spend more than $300,000 in El Paso and the valley within the next eight months. C. W. Kellogg, general manager of the railway company, is in El Paso to complete the final arrangements for the details of line construction. The Stone & Webster Engineering Corporation has been given the contract for the entire work, and bids will be asked from local contractors for grading and right-of-way work, which will be sublet.

TELEPHONE AND TELEGRAPH.

ALBANY, ORE.—J. B. Coffey, receiver for the Northwestern Long Distance Telephone Company, has petitioned the circuit court to allow him to complete arrangements for a joint telephone line from Albany south to other Linn county points with the Home Telephone Company.

VANCOUVER, B. C.—The British Columbia Telephone Company received word of the complete destruction of the company's exchange at Abbotsford. The loss to the telephone company in the way of switchboard and equipment will amount to about $4000, and the value of the frame building will add $2000 to the loss.

TAFT, CAL.—The Standard Oil Company is preparing to connect its Lost Hills, Belridge and Midway field properties with a private telephone line similar to that now in use in the Midway fields. Materials are now arriving for the system and many of the poles have been distributed between McKittrick and the Lost Hills leases. The line when completed will be more than 50 miles long, having connection with nearly 30 miles of laterals in the Midway fields. It will be one of the longest private lines in the oil fields district.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company has retired $5,000,000 two-year 5 per cent notes from the proceeds of the $12,350,000 preferred stock which was sold to the American Telephone & Telegraph Company shortly before the California public utility act went into effect. Of the $32,000,000 six per cent cumulative preferred stock authorized, the American owns $21,727,000, including this $12,350,000. The $750,000 Sunset Telephone & Telegraph first 6s, due July 1, 1913, will be taken care of by the sinking fund.

INDUSTRIAL

UTAH LIGHT & RAILWAY COMPANY'S PLANT AT SALT LAKE CITY, UTAH.

An instance of extremely rapid power plant construction has recently come to light in connection with the extension to the Jordan steam station of the Utah Light & Railway Company at Salt Lake City by Westinghouse, Church, Kerr & Co., constructing engineers, of New York City.

The original station was designed and built by the same engineers in 1910, and consisted of an 8500 kw. single unit steam turbine station, designed to act as an adjunct to various hydroelectric plants operating in the vicinity, and also to form the nucleus for such steam-generating equipment as might be later required to serve Salt Lake City. The operating conditions covering the original plant were as follows:

Utah Light & Railway Co's Plant, Salt Lake City, Utah.

First—Wyoming coal to be used, carrying about 11,700 B.t.u. per pound.

Second—Ample condensing water, but unsuitable for boiler feed.

Third—Feed water to be purchased at comparatively low cost.

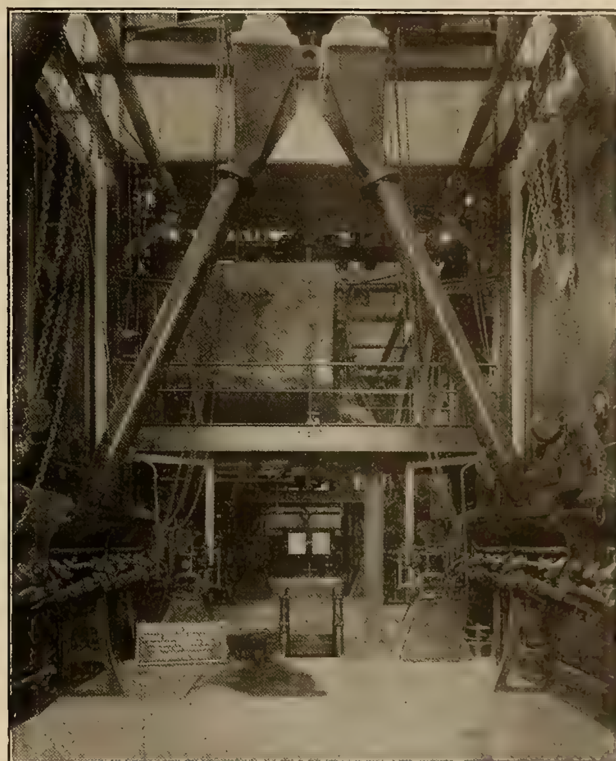
Fourth—Operation not continuous at first.

The new work, which consists of an extension to the old station, comprises in general a brick and steel building approximately 100 x 60 ft. The building walls rest on a pile concrete mattress composed of 36 ft. piles, overlaid with about 3 ft. of concrete. Condenser intake and overflow flumes are formed in the foundations.

The boiler room consists of a steel frame structure, supporting overhead coal bunker, with brick walls, concrete slab floors and roof. The turbine room is similarly constructed, the only steel, however, being in the crane rails, floor beams and roof trusses.

The boiler equipment consists of six Stirling boilers and Roney mechanical stokers, supplied with natural draft by means of a radial brick stack 11½ ft. in diameter by 228 ft. in height. The boilers operate at 200 pounds' pressure and 125 degrees superheat. Piping is thoroughly modern, designed with welded flanges for high pressure work and cast steel fittings and valve bodies. Valve seats, discs and spindles are of Monel metal, particular attention being given to providing for expansion and contraction in view of the high steam pressure and superheat.

In this station it was not necessary to store coal in large quantities, so the coal and ash-handling equipment is comparatively simple. It consists of a track hopper, into which coal is dumped from railroad cars, and carried by an inclined bucket conveyor up to the top of the boiler house, which it dicharges on a horizontal belt, by which it is



In the Boiler Room of the Power Plant.

distributed through the length of the bunker over the boilers. Ashes are dumped from ash jets into side dump cars, which run on an industrial railroad in the boiler room basement, are lifted to ground level by an elevator, and run out by hand to dump on adjacent land which is being filled.

Natural illumination of the boiler room is especially good. It is provided for by a system of skylights placed just beneath the coal bunkers. The photograph showing the boiler room interior was taken by natural daylight.

The turbine equipment consists of one Westinghouse-Parsons unit of 8500 kw. capacity, running at 3600 r.p.m., and delivering current at 60 cycles, 3 phases, 4400 volts. The unit is served by a Leblanc condenser placed directly beneath it in the turbine foundation, the condenser having turbine driven air and circulating pumps.

The main generator is provided with the usual air ducts for ventilation, and is excited by a turbine driven set of 100 kw. capacity. General Electric switching apparatus is contained in concrete cells, and the ring type of bus is used to secure the desired flexibility in switching operations.

The record of construction is given herewith:

March 27, 1912.—Authorization was received to design and build an extension to the original station, increasing its capacity 100 per cent.

April 1, 1912.—Five days after authorization sufficient progress had been made so that the main generator unit, the boilers, condenser, stack, heater, stokers and piles had been purchased. Inquiries for steel had been sent out and contracts were let for steel on April 3rd.

April 6, 1912.—Ten days after authorization the field organization arrived in Salt Lake and excavation was at once started. Construction office, storeroom and cement sheds were built.

In the Generating Room.

April 19, 1912.—Twenty-three days after authorization the first piles were received, and driving of same was begun, the stack foundations being finished on May 20th.

May 9, 1912.—Forty-three days after authorization stack brickwork was started, together with concrete foundation work. On May 19th brick building walls were begun. On May 21st boiler foundation piers were started, and on May 28th steel framing for boiler room floor was begun.

May 27, 1912.—Sixty-one days after authorization the boilers began to arrive, and sheet piling for condensing water intake and overflow flumes was started.

July 8, 1912.—One hundred and three days after authorization piping erection was commenced.

July 10, 1912.—One hundred and five days after authorization steam end of main generating unit arrived and was unloaded and put in position, condenser having been unloaded and placed about a week previously.

August 1, 1912.—One hundred and twenty-six days after authorization all structural work was finished, including brick walls, floors and roof, three boilers had been erected and tested, and five out of the six stokers erected.

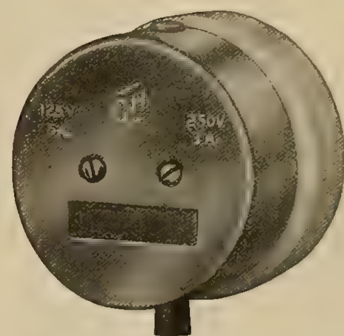
August 6, 1912.—One hundred and thirty-one days after authorization main generator arrived and was placed on foundations; auxiliary work, wiring up and miscellaneous work went rapidly forward until August 26—152 days after authorization, the station was put under commercial load.

It is believed that this record has never been exceeded when the size of the station and its location is considered.

The work was designed and constructed by Westinghouse, Church, Kerr & Co., under the direction of Mr. O. A. Honnold, electrical engineer of the Utah Light & Railway Company.

CUTLER-HAMMER PUSH BUTTON SURFACE SWITCH.

The Cutler-Hammer Manufacturing Company has added to the rectangular base surface switches designed for moulding work a new type of circular base surface switch, which is made in two styles, No. 7107 having a label holder and



Push Button Surface Switch.

No. 7108 having a plain cap without label holder. Where a number of switches are located at one place the No. 7107 switch is adapted, as each may carry a label indicating the circuits or lamps controlled. A push bar, with a light button at one end and a black button at the other, does away with the usual protruding button, which may be broken off, or, by turning the wrong way, be removed and lost. The rating of the 7107 and 7108 switch is 5 amp. 125 volts, 3 amp. 250 volts (National Electrical Code Standard).

A THREE-HEAT CORD SWITCH FOR HEATING DEVICES.

There are many electric heating devices now on the market that are designed to operate at several "heats." Such devices as electric water urns, chafing dishes, heating pads, frying pans, table stoves, tailor's irons, etc., are advantageously operated at a low heat, medium heat and high heat. For the convenient control of these devices The Cutler-Hammer Manufacturing Company of Milwaukee has augmented its line of feed-through or cord switches by the addition of a three-heat brass shell type. This switch can be placed on the cord in the most convenient location for operation.

There are two push bars, each having a light and black button, which operate twin mechanisms so arranged that the pushing of one light button gives low heat, while the other, operated alone, gives medium heat. The shell is plainly marked, so that the operator may know which button to press for low and which for medium heat. To get high heat both are pushed. The operation is positive and snappy, and one hand only is needed for the manipulation of the push buttons.

NEW CATALOGUE.

Bulletin of "1913 Suggestions in Illuminating Glassware," from the Holophane works of General Electric Company, lists some 75 recent additions to the Fostoria lines of artistic glassware. The new styles cover a wide range of applications—hexagonal shades with cut or etched designs for shower fixtures, artistically designed globes for hanging units, Veluria portable lamps for the home, ice-etched shades in novel and popular designs for chandeliers or wall brackets, and Veluria hanging bowls for semi-indirect lighting.

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Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps, Incandescent
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Lamps, Tantalum
General Electric Company
Pacific States Electric Co.

Lamps, Tungsten
Brilliant Electric Co.
General Electric Company
Johns-Manville Co., H. W.
"Star," Kendrick Elec. Co., Jos. Thieben & Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pierson, Roeding & Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
General Electric Company
Moore & Company, Chas. C.
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
Fairbanks, Morse & Co.
General Electric Co.
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Pittsburg Piping & Equip. Co
Moore & Co., Chas. C.

Plugs, Flush
General Electric Company
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Pacific States Electric Co.

Pneumatic Tools
Rix Comp. Air & Drill Co.

Poles, Iron and Steel
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks. Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo.
(Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Purifiers, Live Steam
"Hoppes," "Stilwell," Moore & Co., Chas. C.

Push Buttons
Pacific States Electric Co.

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
Pierson, Roeding & Company
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Regulators, Boiler Feed
"Copes," Moore & Co., Chas. C.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

Searchlights
"Dayton," Elec. Agencies Co.
Fort Wayne Electric Works
General Electric Company

Separators, Steam
"Stratton," Moore, Chas. C. & Co.
Pittsburg Piping & Equip. Co.

Shades
Benjamin Elec. & Mfg. Co.

Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
"Freeman," Elec. Agen. Co.
General Electric Company
Pacific States Electric Co.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.

Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.

Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.

Surveying Instruments
Post Co., The Frederick

Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.

Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Steel Castings
Columbia Steel Co.

Street Cars
"Brill," Pierson, Roeding & Co.

Switches, Float
General Electric Company
Westinghouse E. & M. Co.

Switches, Disconnecting
General Electric Co.

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, 159 New Montgomery
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco, 57[illegible] Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Moloney Electric Co.
San Francisco, Rialto Bldg.

Moore, Chas. C. & Co.
San Francisco, 99 First
Los Angeles, American Bnk Bldg
Seattle, Mutual Life Bldg.
Portland, Wells-Fargo Bldg.
Salt Lake City, Atlas Bldg.
Tucson, Arizona.

Nason & Co., R. N.
San Francisco, 151 Potrero Ave.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific States Electric Co.
San Francisco, 131 N. Montgy.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 523 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 703 Spaulding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
San Francisco, Monadnock Bldg

Post Co., The Frederick
San Francisco, 135 Second

Safety Ins. Wire & Cable Co.
San Francisco, 589 Howard

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg.

Tracy Engineering Co.
San Francisco, 461 Market
Los Angeles, Central Bldg.

K-P-F Electric Co.
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.

Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Westinghouse E. & M. Co.

Switches, Knife
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.

Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.

Switches, Push Button
"M. & M." Elec. Agencies Co.
Pacific States Electric Co.

Switches, Snap
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Switches, Solenoid
The Cutler-Hammer Mfg. Co.

Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.

Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.

Tanks, Steel.
Western Pipe & Steel Co.

Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.

Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Pacific States Electric Co.

Tel. Protectors and Terminals.
"Cook," Elec. Agencies Co.

Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.

Towers, Steel.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company

Transformer Winding.
K-P-F Electric Co.

Tubes and Bushings
Ohio Brass Company

Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Moloney Electric Co.
Westinghouse E. & M. Co.

Trolley Bases
Ohio Brass Co.
Holabird-Reynolds Co.

Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Westinghouse Machine Co.

Turbines, Water.
Pelton Water Wheel Co.

Valves
"Chapman," Moore & Co., Chas. C.
Pittsburg Piping & Equip. Co.

Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.

Washing Machines
Pacific States Electric Co.

Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee,"Simonds Mchy Co.

Wire, Aluminum.
Pierson, Roeding & Company

Wire, Annun's and Office.
Standard Und. Cable Co.

Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.

Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.

Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Pierson, Roeding & Company
Standard Und. Cable Co.

Wire, Enameled.
General Electric Co.

Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.

Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.

Wire, Trolley.
Bridgeport Brass Company

Wire, Weatherproof
General Electric Company
National Con. & Cable Co.,The
Okonite Company, The
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.

Van Emon Elevator Co.
San Francisco, 56 Natoma.

Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758W.Broadway

Westinghouse E. & M. Co.
Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.

Westinghouse Machine Co.
San Francisco, 141 Second

Weston Elec. Instrument Co.
San Francisco,682-684 Mission

Wilson Machinery Co.
San Francisco, 361 Market

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Publisher's Note: The front cover of this journal will hereafter be used to show the contents of the paper, both editorial and advertising. No further display advertising will be contracted for this space.

LEADING ARTICLES IN THIS ISSUE

The Journal of Electricity, Power and Gas tells by picture and story of the wonderful power projects and electrical developments in that growing empire from the Rockies to the Coast.

MATERIALS ADVERTISED IN THIS ISSUE

Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages 9, 10.**

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX | SAN FRANCISCO, JANUARY 18, 1913 | NUMBER 3

COST DATA ON SMALL ELECTRIC PUMPS

BY ROBERT SIBLEY.

Definite costs on installing pumps with the necessary electrical equipment can now be computed with much exactness. The district served by the Western States Gas & Electric Company in and about Stockton, California, has recently witnessed an energetic sales campaign to supply electric power to the hundreds of farms in this vicinity. Water can usually be found in sufficient quantities at a depth of between 30 and 40 ft., or less. Here are to be found the great Tokay vineyards of the State, which the experience of the past season has demonstrated presents opportunities for the power salesman.

Twin Well Supplying 1500 Gallons of Water Per Minute.

Near Acampo, on the railroad between Stockton and Sacramento, Walter V. Jahant has installed and put into successful operation a 1600 gallon per minute pumping plant the detailed costs of which will undoubtedly prove of interest to others contemplating a similar installation.

It was at first considered advisable to attempt to pump only 1000 gallons per minute upon a certain portion of this property which was to be set out in alfalfa. As this seemed to have been the upward limit for wells in this district, many thought it inadvisable to attempt the installation of a larger pump. Typical of that spirit of western enterprise, however, Mr. Jahant decided to "go one better" than previous accomplishments had wrought. Consequently twin wells were sunk 22 ft. between centers and the suctions from each well were joined at the center of the horizontal connection. By means of a tee placed at the center of this horizontal pipe connection is made to the pump.

Upon calling for bids for various sizes of pumps, the following general data were given to each bidder:

Pit 12 ft. deep. Water in the morning 7 ft. below pump; at noon 14 ft. below pump; at night 16 ft. below pump. Pump to be installed 12 ft. below the surface.

This preliminary information was compiled from data taken from a gas engine pump on the ranch, situated about 2000 ft. from the proposed well. The following responses from various manufacturers and dealers were received:

Bid No. 1.

We propose to furnish the following material and labor for the pumping plant of Mr. Walter Jahant at Lodi, Cal.: 6 in. horizontal centrifugal pump, Dow or equivalent; 15 h.p., 3-phase, 60 cycle, 220 volt, 1800 r.p.m. General Electric motor, complete with sliding base, pulley and starting compensator with no voltage release. Overload cut out; line switch and fuses; 30 ft. wrought iron 8 in. suction casing; 15 ft. wrought iron 2 in. discharge casing; 6 in. x 8 in. increasing check valve priming pump and fittings; 35 ft. 6 in. Ruboil belting. Also the labor to install and wire the above in a good and workmanlike manner on the customer's foundations, to make a complete and operating pumping plant, for the sum of $475 f.o.b. San Francisco. We will further guarantee the above plant to supply 1000 g.p.m. from a depth of not more than 35 ft. with the above motor, provided the well will give that much water.

Bid No. 2.

We propose to furnish the following material and labor for Mr. Walter Jahant's pumping plant at Lodi: 8 in. horizontal centrifugal pump, Dow or equivalent; 20 h.p., 3-phase, 60 cycle, 220 volt, 1800 r.p.m. General Electric motor, complete with sliding base, pulley and starting compensator with no voltage release. Overhead release; line switch and fuses; 30 ft. 10 in. wrought iron suction casing; 15 ft. 10 in wrought iron discharge casing; 8 in. x 10 in. increasing check valve; priming pump and fittings; 35 ft. 6 in. Ruboil belting. Also the labor to install and wire the above in a good and workmanlike manner on the customer's foundations, to make a complete and operating pumping plant, for the sum of $600 f.o.b. San Francisco. We will further guarantee the above plant to supply 2000 g.p.m. with a Dow pump, or 1600 g.p.m. with a closed runner pump from a depth of 25 ft. or less with the above motor, provided the well will give that much water.

As the 20 h.p. motor gives a very small margin of safety in case the water should drop further than anticipated, we would prefer to figure on a 25 h.p. 1200 r.p.m. motor at an additional cost of $75.

If Mr. Jahant anticipates installing the larger plant, he will probably have to drill two wells and connect them up to a common suction, as it would be exceptional to find one well that would furnish sufficient water for an 8 in. pump. In that case we will be pleased to figure on the additional cost of such a layout of piping when the specifications are decided upon.

Bid No. 3.

We propose to furnish the following equipment: 1-8 in. Byron Jackson or Dow centrifugal pump; 1-20 h.p. Westinghouse or General Electric motor complete with automatic starter, low voltage release switch, wiring, etc., complete, 1-Type H overload relay circuit breaker. The above to be installed complete and ready for operation, including belting, check valve, suction 8 in., with 12 in. dicsharge, for th esum of $699.28. Owner to dig pit-bore well and lay foundation for motor.

No. 3 was the one accepted. It is interesting to see what the complete costs eventually totalled, taking into account, the extras; such as the digging and concreting of the pit and in fact all expenses connected with the installation. These expenses thus considered in detail, were the following:

Tabulation of Cost Data.

Equipment:		
Pump and 25 h.p. motor as per bid	$699.28	
1-35 ft. piece, 8 in. O. D. casing	26.95	
2-9 ft. 5 in. pieces O. D. casing	16.94	
2-8 in. flanged elbows	12.80	
2-8 in. casing flanges	23.93	
5-sets bolts and gaskets	3.55	
1-8 in. tee	20.63	
Extra labor	10.00	
		$814.08
Concrete Work: (This consisted of concreting the entire interior 4 in. thick, reinforced, with 5 pieces tapering from 12 in. to 0 in. No cost is made for the sand, as this was taken from the well-boring sand, being found of excellent quality. The gravel was hauled 15 miles and no actual cost being made for the gravel itself).		
Gravel:		
4 horses, 4 days at $1.00 per day	$ 16.00	
Labor: I man, 4 days at $2.25 per day	9.00	
Cement: 61 sacks at 65c per sack	39.65	
Cartage on cement—2 horses and 1 man ½ day	3.25	
Labor on setting concrete	21.00	
Concrete forms 2 men 2½ days at $2.25 per day	13.00	
Lumber for concrete forms and for pump house, 1,000 ft. at $25.00	25.00	
		126.90
Pump House (lumber used from concrete forms):		
3500 shingles at $2.50 per M	$ 8.75	
Sheeting	5.00	
Labor on building	13 25	
Nails	1.00	
		28.00
Main Excavation:		
Pit 10 ft. deep, 10 ft. wide, 6 ft. to runaway	$ 24.75	
Cost of second pit and levelling off first pit	25.25	
		50.00
Well Sinking:		
Boring two wells 12 in. diameter—150 ft. and the other 350 ft. deep over surface of the ground	$ 63.25	
(Usual charge is for ½ pit depth, but in this case, charges were made for 40 and 43 ft., respectively).		
Cost of pumping quicksand encountered, 6½ days at $14.00 per day	91.00	
Express charges	9.00	
		163.25
Priming Pump:		
Priming pump	$ 5.00	
Iron ladder consisting of 9 pieces 2 ft. 6 in. x ¾ in.	1.50	
		6.50
Grand total		$1,888.73

This pump is now in successful operation. As may be seen from the illustrations shown herewith, an eternal insurance against a recurrence of a dry season is thus ever at hand.

REPORT OF OREGON CONSERVATION COMMISSION.

The fourth annual report of the Oregon Conservation Commission to the Governor shows that unused streams in Oregon are capable of producing 3,300,000 h.p. These streams are also capable of supplying water to irrigate fully 4,000,000 acres of land, half of which can be irrigated at a cost of $30 to $60 per acre. Of the 686,129 acres of irrigated land in the state, 3.2 per cent has received water through the U. S. Reclamation Service, 3.6 per cent through the Carey Act, 11.3 per cent through commercial enterprises and most of the balance through individual or partnership enterprise.

The Commission recommends submission to the people of a constitutional amendment poviding for a bond issue for irrigation and water power development by the state in co-operation with the U. S. Geological Survey. It also recommends state construction and control of sufficient power projects to regulate the market and insure cheaper power.

The report contains the complete text of the Water Code of Oregon with comments on its operation. The law has greatly stimulated investments, and the determination and recording of early rights has progressed rapidly. Twenty-three separate stream systems have already been surveyed, involving about 275,000 acres of irrigated land. Over 2000 claims to water have been filed with the Board of Control, and complete determinations made on fifteen stream systems, affecting 1018 separate rights and 106,686 acres of irrigated land.

LIGHTNING PROTECTION OF TRANSMISSION LINES

BY ALFRED STILL.
Member A. I. E. E., Inst. E. E.

Spark-Gap Arresters With Circuit Breakers or Re-Setting Fuses.

If the resistance in series with a gap arrester is very small, a good path is provided to ground for taking a very heavy discharge; but there will be a large flow of power current in the arc following the discharge. This current may be interrupted by connecting some self-acting device such as a fuse or automatic circuit breaker in the ground connection; and arresters, whether of the horn type or with any other kind of spark gap, are now made with fuses so arranged that when one fuse blows, the dropping of a lever or an equivalent device, automatically inserts another fuse, so that the system is not left unprotected. Even without automatic replacement, if a number of gaps with fuses are connected in parallel, it will generally be found that one discharge will not blow all the fuses, and that during the passage of a single storm, the line will be adequately protected.

In the Garton-Daniels arrester, for use on a.c. circuits up to 20,000 volts, the principle of the multiple gap is combined with a simple type of automatic circuit breaker connected as a shunt to some of the spark gaps, in order that the discharge path for the lightning shall remain unaltered even during the operation of the arrester. The arrester is built up of several unit parts connected in series; each unit being rated for 3300 volts. The ilustration, Fig. 5, shows a complete single-phase arrester for 10,000 volts. On a 20,000 volt circuit, there would be eight units in series, the total air gap distance being 1⅛ in., with a series resistance averaging 3800 ohms. The diagram Fig. 6 refers to a single unit of the Garton-Daniels arrester. The discharge follows the straight path through the two sets of air gaps and the resistance rod, as indicated by the round dots. The power current following the discharge will, after passing through the two upper gaps and the resistance rod, be shunted by the low resistance winding of the circuit breaker; and if this following current is too heavy to be ruptured by the combined action of these two gaps and the resistance rod, the iron armature of the circuit breaker will be lifted by the action of the solenoid, thus throwing the two lower spark gaps in series, and extinguishing the arc.

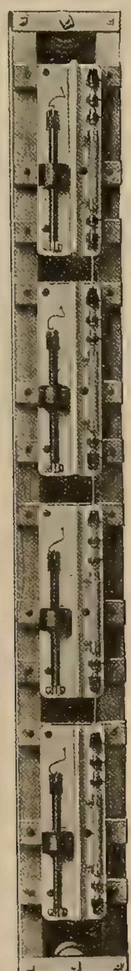


Fig. 5. Single-Phase Lightning Arrester for 10,000 Volts.

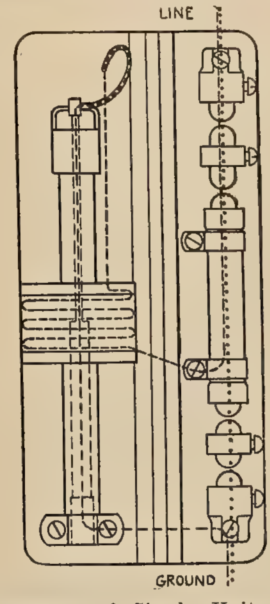


Fig. 6. Diagram of Single Unit of Multiple Arrester.

Aluminum Cell Arrester.

When two aluminum electrodes are immersed in a suitable electrolyte, an insulating film of hydroxide of aluminum is formed on the surface of the metal, which effectually prevents the passage of any appreciable amount of current until a certain critical voltage is reached, when this film breaks down and the current is limited only by the resistance of the electrolyte. On lowering the voltage, the film is re-formed and the flow of current again limited to a very small amount.

With alternating currents, the critical voltage per pair of plates is about 350 volts, and the practical construction of lightning arresters on this principle consists in stacking a large number of cone-shaped aluminum plates one within the other, with suitable separating washers of insulating material between them. In this manner a column is formed of a large number of cells in series, capable of withstanding high volt-

ages. The whole is enclosed in a cylindrical case containing oil, which improves the insulation and prevents the evaporation of the electrolyte which fills the spaces between adjacent trays within a short distance of the edge.

If cells built up in this manner are connected directly between line and ground, there will be an appreciable current passing through them, which is partly a leakage current, but chiefly a capacity current. It is therefore customary to insert a spark gap, usually of the horn type, in series with the aluminum cell arrester; the gap being set to break down with a pressure slightly in excess of the normal working voltage.

Although the film of hydroxide is formed on the plates at the factory before the arresters are installed, it is necessary to maintain it by periodic "charging" of the cells; this being done by closing, or nearly closing, the spark-gap in series, so as to put the full line pressure across the arrester. It is generally recommended that this be done once every day.

In principle the aluminum cell arrester would appear to offer an ideal solution of the problem of lightning protection; because, once the critical voltage is exceeded, and the film broken down, a very large current—depending on the amount of separation and the area of the plates, and also the nature of the electrolyte—is allowed to pass to ground; and the device is capable of dealing with continual surges, such as will occur with an intermittent ground, for a period of about half an hour without excessive heating. In practice it has proved fairly satisfactory, especially on the higher voltages; but, apart from its large initial cost, it has frequently been found to be somewhat costly in upkeep, as the aluminum cells are liable to become damaged through frequent and heavy discharges, and have to be periodically reformed or replaced. Then again, the necessity of charging with the line current is an objection where there is not an operator constantly in attendance; and lastly, it must not be overlooked that the device suffers from the disadvantage common to all spark gap devices, namely that high frequency surges are liable to be set up in the system when the spark gap discharges. In this particular case the trouble is liable to occur, not only when the horn gap breaks down while fulfilling its function of discharging an excess of pressure through the cells, but also when the spark is deliberately formed for the purpose of charging the cells. On very high pressure systems it is possible that the surges set up by spark gaps in series with the resistance of the cells are not likely to cause trouble; but this suggests the possibility of simpler and less costly devices such as the graded horn gaps previously referred to, being equally effective. On the other hand, when used on low voltage systems operating at about 11,000 volts, (especially if the generators are directly connected to the transmission line, without the intervention of step-up transformers) the operation of charging the aluminum cell arresters in the generating station has been known to break down the insulation of the generators.

Condensers.

Although much has been done, and more good work will probably be done in the future by the intelligent "grading" of a number of spark gaps, to afford a path to ground and yet avoid the setting up of dangerous high frequency surges, the objections to all spark gaps are (1) the necessity of an appreciable increase in pressure above normal line pressure to break down the resistance of the gap, and (2) the danger of an oscillatory current being set up in the network of conductors.

Consider any single spark gap, such as the horn type, with a resistance in the ground connection. If this resistance is less than twice the quantity which Dr. Steinmetz has named the natural impedence of the circuit, the interruption of the current passing to ground is liable to set up dangerous high frequency oscillating currents in the wires and apparatus connected thereto; and, on the other hand, if the resistance is greater than this critical value, it may be too high to afford much relief in the event of suddenly applied electric impulses.

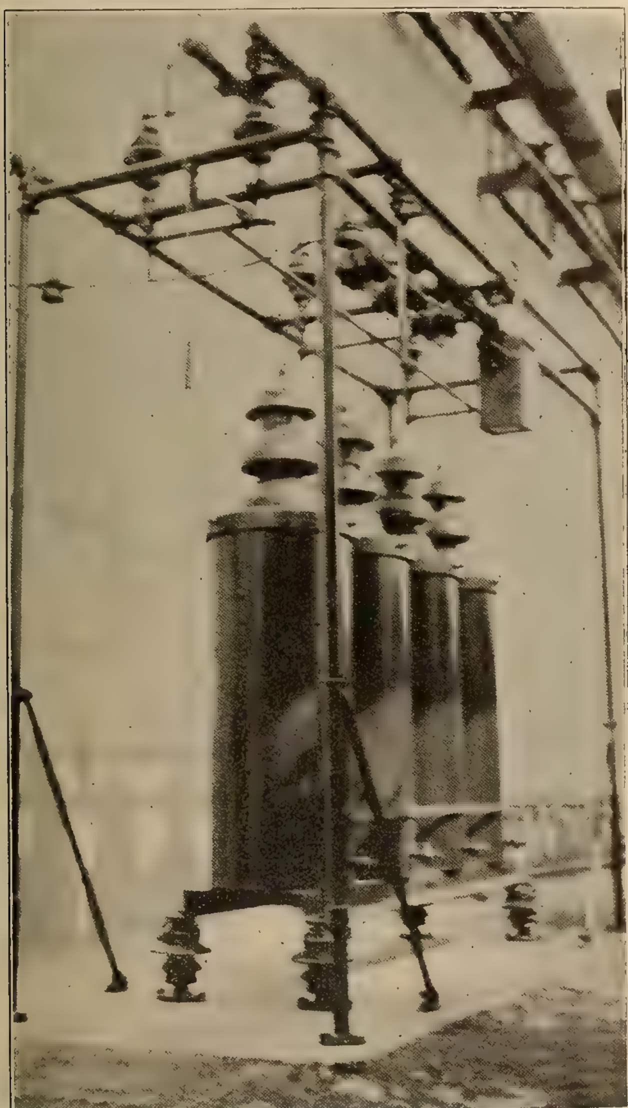
As stated at the beginning of this article, the natural impedence of a circuit is the square root of the ratio $\frac{\text{inductance}}{\text{capacity}}$ or $\frac{L}{C}$ which, in the case of overhead transmission lines will have a numerical value between 200 and 500 ohms. Assuming this to be 350 ohms, it will be seen that the resistance in the ground connection must be at least twice 350, or (say) 800 ohms in order to avoid the production of high frequency oscillations.

If the spark gap can be avoided, this high series resistance in the ground connection becomes unnecessary. A non-inductive direct connection to ground can obviously not be made on a high tension alternating current overhead transmission line; but a path to ground may be provided either through a highly inductive choke coil, or through a condenser, or both, without the necessity of providing a spark gap in series. The inductive resistance may easily be designed to pass only an inappreciable current of the normal or higher frequency, and it will therefore be useless as a means of relieving the line of a static charge. The condenser, however, acts as an almost perfect insulator so far as direct currents are concerned; but it is pervious to high frequency currents, and a suitably designed condenser, or rather battery of condensers, connected between line and ground without the intervention of any spark gap is certainly an ideal device for dealing with the very high frequency oscillations that accompany lightning phenomena. This is the chief function of the Mosciki condensers which, although not largely used on this continent, have found favor in Europe, where they have been in use for many years in almost every country, and also in South Africa and China.

As previously stated, the travelling waves induced by a lightning discharge on a transmission line have a frequency of the order of 1000 to 5000 cycles per second, and a set of condensers which will not pass any but a very small current at 25 or 60 cycles, will deal with much larger currents on these higher frequencies. As a matter of fact, an electric discharge between cloud and ground or between cloud and cloud may induce in the line travelling waves having frequencies considerably in excess of 100,000 per second. This is proved by the fact that wireless telegraphic apparatus which

responds only to frequencies ranging between about 100,000 and 1,000,000 cycles per second is interfered with by atmospheric electric storms. A 40 ampere fuse in series with a condenser has been blown during atmospheric discharges although the condenser could not possibly pass more than a hundredth part of this current on frequencies of 3000 to 4000.

It is perhaps not generally understood that high frequency travelling waves may break down the insulation of generators or transformers even when the voltage of these induced charges is small as compared



Electrolytic Lightning Arresters in Use by a Western Power Company.

with the normal operating voltage. The trouble is that the wave is short; it has a steep front, and the point of zero potential may be only a few hundred feet behind the point of maximum potential. If, therefore, a travelling wave of this nature enters a piece of electrical machinery such as a generator or transformer, the full difference of potential, which may amount to only a few thousand volts, may be applied across adjacent layers of the coil winding, thus causing a puncture and ultimate break down of the insulation, even if the apparatus as a whole is insulated to withstand pressures of 100,000 or 200,000 volts to ground. As a protection against trouble of this sort from high frequency induced charges, the condenser appears to offer a good solution.

It must not be understood from the foregoing notes on the uses of condensers as lightning arresters that the discharge is diverted to ground through the condenser and so dissipated, much as energy would be dissipated in a resistance, because the condenser cannot absorb or dissipate any but the smallest percentage of the energy passing through it. The energy is necessarily re-delivered to the line from which it originally came, and is ultimately dissipated through the ohmic resistance of the conductors; but the steepness of the wave front has been diminished. The function of the condenser is, in fact, somewhat analogous to that of an air chamber on a water pipe in which the rate of flow is subject to sudden variations.

U. S. FORESTER'S REPORT ON WATER POWERS.

The annual report of U. S. Forester Henry S. Graves estimates that about 12,000,000 h.p. can be developed from the natural flow of streams in the national forests. This amount can be increased greatly through the regulation of stream flow by storage. Numerous excellent reservoir sites are available.

The regulations adopted by the department on December 28, 1910, have now been in force long enough to demonstrate their practicability. On the whole, they are favorably received by developers. The propriety of making a charge for the use of the land occupied and the reasonableness of the amount fixed by the regulations is generally conceded. That feature of the permit which requires development to be made within a reasonable time is working satisfactorily and is serving to keep out speculators who have hitherto sought to appropriate sites only that they might later dispose of them to the real developer.

The following table shows the extent to which water power development is taking place on the national forests:

	Transmission lines only.	Reservoirs, conduits, power houses.
Permits in force June 30, 1912:		
Commercial—Preliminary	..	39
Final	73	84
Noncommercial	5	62
Total	78	185
Projects operating June 30, 1912:		
Commercial	60	56
Noncommercial	4	28
Total	64	84
Projects on which construction had begun June 30, 1912:		
Commercial	6	29
Noncommercial	...	16
Total	6	45

	Transmission lines only.	Reservoirs, conduits, power houses.
Permits issued from July 1, 1911, to June 30, 1912:		
Commercial—Preliminary	..	29
Final	22	26
Noncommercial	..	16
Total	22	71
Applications received from July 1, 1911, to June 30, 1912:		
Commercial—Preliminary	..	46
Final	20	25
Noncommercial	3	21
Total	23	92

ELECTRICAL PUMPING AND IRRIGATION

CLASSES OF WEIRS.

BY B. A. ETCHEVERRY.

Diversion weirs belong to two general classes, closes weirs and opened weirs.

Closed weirs are weirs built solidly across the rivers so that the entire stream flow passes over it. To this class below the brush weirs, cobble weirs, pile weirs, crib weirs, either continuous or built up of separate cribs, wooden frame weirs, steel frame weirs, reinforced concrete weirs, concrete or masonry weirs, and loose rock weirs of Indian type.

Open weirs are weirs built across the river so as to afford least obstruction to flow. They may consist of piers or columns with the opening between controlled by gates or may be collapsable gates with no piers. To this class belong the following:

Wooden frames or buttresses with openings controlled by flashboards.

Wooden frames or buttresses with openings controlled by lift gates.

Concrete or reinforced concrete buttresses or columns controlled by wood or steel gates.

Small Combination Crib Diversion Weir and Fish Ladder in British Columbia.

Steel frames with openings controlled by wood or steel gates.

Collapsable gates.

The selection of the type of weir will depend on the character of stream flow, the effect of the weir on the lands above the weir, the character of foundation, the permanency desired and amount of money available, and the availability of the material of construction. An open weir is to be used in preference to a closed one where the obstruction formed by a closed weir would cause flooding of land above, or formation of islands on the upstream side of the weir. Collapsable weirs are used where the obstruction of piers or columns must be prevented, such as where the volume of flood flow and the amount of floating debris is great. Closed weirs are self acting, do not require operation of gates and will permit the passage of ice, trees and other floating material which would obstruct the openings of an open weir.

Brush and cobble weirs are generally used for temporary low weirs and may require yearly renewal. They are used where cobbles are plentiful and where

Brush nad Cobble Dam Near Rumsey, Cal.

the amount of money available and the character of the irrigation system will not justify the expenditure of a more substantial structure. The foundation is generally sand, cobbles or boulders.

Pile weirs are used on sandy streams and for low weirs.

Crib weirs are used where lumber and rock are plentiful and preferably where the stream flow is sufficient to pass over the weir continuously and keep the wood wet. Weirs built of separate cribs are easier to construct in flowing water than are continuous weirs.

Wooden frame weirs are used where lumber and rock are not plentiful. They consist of a strong floor nailed to heavy pieces placed in the bed of the river and across it in the direction of the axis of the weir,

Low Concrete Diversian Weir and Headgate Showing Formation of Sand and Gravel Islands on Upstream Side, Due to Great Length of Weir and Absence of Scouring Sluices, Umatilla, Ore.

to which is belted and fastened the wooden frame which supports the sheathing which forms the up-

stream face of the dam. The stability of this dam depends mainly on the pressure of water on the upstream face. The slope of this face should not be steeper than 1 vertical to 2 horizontal. When the foundation is sand sheet-piling is driven along the upstream and downstream edge of the floor and good connection made with the floor. The sheet-piling should be driven in the sand a depth equal to about twice the height of water on the upstream side of the dam. The floor should extend far enough downstream to protect the bed from the erosion caused by the falling water. When the foundation is rock the floor should be bolted to it and good connection made with it at the upstream and downstream edge of the floor.

Removable Flashboard Diversion Weir of Moore Ditch, Yolo County, Cal. Courtesy of Irrig. Investg., U. S. D. A.

Steel frame weirs are similar to wooden frame weirs but more durable.

Reinforced concrete weirs are usually cheaper than solid concrete weirs and are better on a foundation other than solid rock because of their greater elasticity. In some cases the high cost of concrete because of inaccessibility may prevent the adoption of any type of concrete weir.

Concrete and masonry weirs have the great advantage of strength and durability but their use is largely limited to solid rock foundations. Concrete weirs of the Ogee type are satisfactory on solid foundations. Concrete weirs with direct vertical fall on a thick apron or in a water cushion are well adapted to loose soft foundation.

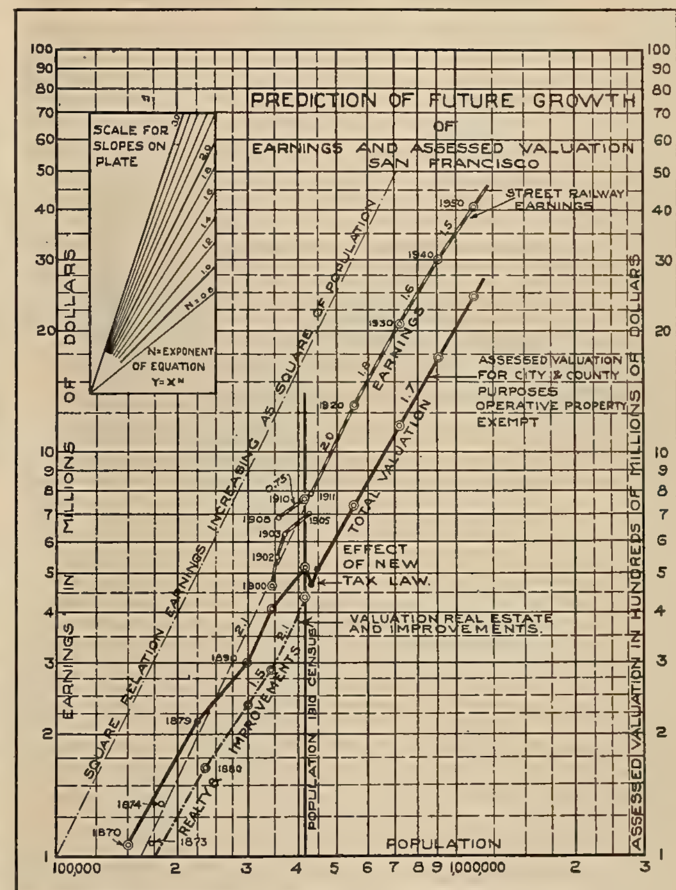
Loose rock weirs of the Indian types are especially suitable for unstable soft foundations and where a large volume of water passes over it during flood time.

The various types of open weirs differ mainly in the material used and in the size of the openings between piers or buttresses. The material available and the amount of money which one is justified in spending will largely determine whether wood, steel or concrete should be used. The character of stream flow will determine the desirable size of opening. Where the stream carries a great deal of floating debris or ice the openings should be made to prevent obstruction and the following types of construction may be necessary.

1. Make the operating platform removable for at least a portion of the weir.
2. Provide a wide log way.
3. Make a porton of the weir collapsable.

SAN FRANCISCO'S PREDICTED TRANSIT GROWTH.

Bion J. Arnold's Preliminary Report No. 19 to the Board of Supervisors of San Francisco is concerned with the growth of traffic and investment in transit facilities, giving an exhaustive analysis of past and present growth and a conservative prediction of future requirements. The conclusion is that if the city of San Francisco declines to accept the assistance of private capital in financing its utilities a revision



Analysis of Mathematical Law of Growth.

Upon this law rests the future of the city in respect to transit earnings and investment in the necessary railway properties. It answers the question, How fast will earnings and investment grow with reference to the population? San Francisco has exceeded many other cities in the past, with earnings growing faster than the square of the population; and valuation of property somewhat below this rate. This means that when the population doubles, property valuation more than triples, and earnings quadruple. The broken guide line indicates the square relation. A line parallel thereto conforms to this law. For the distant future the rate of earnings has been conservatively decreased, as this study refers largely to surface transportation, and not including expensive rapid transit projects.

of the present $51,000,000 bond limit must be secured immediately in order to provide the capital necessary for preserving the normal rate of growth of the city. It is predicted that by 1930 the railway investment required will be $62,000,000 and by 1059, $123,000,000.

It has been found that the total annual railway earnings increase approximately as the square of the increase in population. This relation is shown graphically in the accompanying chart. It is stated that the earnings of the United Railroads should double in the

next 13½ years—i.e. should reach $16,000,000 by 1924-5—and should quadruple by 1942. Earnings per capita are now the highest in the country—$20 per capita for all companies.

An analysis of growth shows that San Francisco is now growing faster than during the five years before the fire, and at a rate of increase about 145,000 per decade. The real growth of the city, excluding the effect of the fire, has been at the rate of 54 per cent for the last decade, as against 22 per cent shown by the census. At the present time the city contains about 450,000 people. This population will double in 26 years, and will reach 1,000,000 people in 1945. The San Francisco commuter district now has a population of 728,000 people, and has increased 48 per cent in the last decade. This population will double in 23 years, reach 1,000,000 in 1919, and 2,000,000 in 1945.

Since the publication of this report some little criticism has been made of the lowness of the estimates for future growth. These estimates have been made for the purpose of anticipating the necessary railway facilities and are necessarily conservative. It is interesting to note that they average about 15 per cent higher than did those of John R. Freeman in the preparation of his report on the water requirements of the city. In the extension of track mileage San Francisco is at least six years behind the necessities of the growth in population.

POSSIBILITY OF MINE EXPLOSIONS FROM INCANDESCENT LAMPS.[1]

BY H. H. CLARK.

Electric incandescent lamps are used in a large number of mines. Almost all mines in which electric current is available use electricity to some extent for underground lighting. The design and construction of incandescent lamps is such that, when properly installed, they offer ordinarily only a small fire hazard, because the filaments are so quickly broken to pieces when the bulbs are fractured that there is not time to raise to its ignition point material that is merely combustible. The presence of explosive mixtures of gases, however, increases the risk. When an incandescent lamp bulb is broken in an explosive mixture of gas this mixture is brought into violent contact with a wire having a temperature of 1800 to 2000 degrees C., or two to three times the ignition temperature of methane.

Twelve hundred and nineteen incandescent lamps, representing the product of eight manufacturers, were used in the investigation. The lamps were similar to those used for general lighting purposes wherever electric incandescent systems are operated.

The results of the tests are given below in tabular form. This table shows the number of tests of each kind made on each size of lamp and the percentage of ignitions that took place.

Table 3.—Number of tests and percentage of ignitions.

Rating of lamp.	Smash test rated voltage.		Smash test; overenergized lamp.		Smash test; percentage of gas varied from 8.6 per cent		Tip-breaking test.		Puncture test.		Naked filament test.	
	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.
8 candlepower, 50 volts	4	0	6	33	..	.....	5	0	...	.....	..	...
8 candlepower, 55 volts	5	0	3	0	..	.....	5	40	4	100	4	100
30 watts, 50 volts	4	0	6	66.7	..	.....	5	40	...	.....	..	...
30 watts, 55 volts	24	8.3	36	58.3	..	.....	10	30	10	80	..	...
16 candlepower, 55 volts	16	18.7	...	....	..	.....	3	0	2	100	4	100
50 watts, 55 volts	4	25	...	....	..	.....	...	.....	...	.....	..	...
60 watts, 50 volts	10	80	...	....	..	.....	...	.....	...	.....	..	...
60 watts, 55 volts	20	95	...	....	28	60.7	15	60	...	.....	..	...
32 candlepower, 55 volts	5	100	...	....	1	100	8	75	5	60	4	100
100 watts, 55 volts	2	100	...	....	..	.....	...	.....	...	.....	..	...
120 watts, 55 volts	10	100	...	....	24	75	5	60	...	.....	..	...
50 candlepower, 55 volts	7	100	...	....	..	.....	...	.....	...	.....	..	...
155 to 175 watts, 55 volts	8	100	...	....	..	.....	10	80	...	.....	..	...
8 candlepower, 110 volts	8	12.5	18	50	..	.....	7	0	3	100	3	100
25 watts, 110 volts	2	0	5	33.3	..	.....	...	.....	...	.....	..	...
30 watts, 110 volts	12	0	36	44.4	..	.....	15	13.3	15	46.7	..	...
16 candlepower, 110 volts	8	0	19	52.6	3	0	8	12.5	3	100	4	100
50 watts, 110 volts	12	8.3	3	66.7	..	.....	...	.....	...	.....	..	...
60 watts, 110 volts	32	9.4	36	41.7	7	14.3	15	13.3	10	60	..	...
32 candlepower, 110 volts	6	50	...	....	..	.....	2	0	2	100	3	100
32 candlepower, 127 volts	8	62.5	...	....	..	.....	...	.....	...	.....	..	...
100 watts, 110 volts	4	75	...	....	..	.....	5	60	...	.....	..	...
120 watts, 110 volts	48	50	2	50	5	80	15	33.3	...	.....	..	...
50 candlepower, 110 volts	7	85.7	...	....	..	.....	5	100	...	.....	..	...
155 watts, 110 volts	4	100	...	....	..	.....	5	40	...	.....	..	...
175 watts, 110 volts	4	100	...	....	..	.....	5	20	...	.....	..	...
8 candlepower, 220 volts	3	0	8	25	..	.....	5	20	2	100	3	100
35 watts, 220 volts	14	0	42	21.4	..	.....	20	5	18	44.4	..	...
16 candlepower, 220 volts	5	0	12	41.7	..	.....	11	0	5	40	4	100
60 watts, 220 volts	22	4.5	42	57.1	..	.....	15	13.3	15	66.7	..	...
32 candepower, 220 volts	7	0	16	56.3	..	.....	3	33.3	3	66.7	4	100
120 watts, 220 volts	44	2.3	42	50	..	.....	20	20	10	80	..	...
50 candlepower, 220 to 225 volts	20	80	...	....	..	.....	6	66.7	2	100	2	100
190 watts, 220 volts	16	68.7	...	....	..	.....	10	50	...	.....	..	...
20 watts, 110 volts	7	85.7	...	....	..	.....	4	75	...	.....	..	...
20 watts, 220 volts	14	28.6	...	....	..	.....	6	0	...	.....	..	...
Total	426	.....	333	....	68	.....	248	.....	109	.....	35	...

[1]Abstracted from Tech. Paper 28, just issued by the Bureau of Mines.

READINESS TO SERVE METHODS

IRRIGATION.—THE GRAVITY WAY.

BY R. B. MATEER.

"Back to the land" and the hunger of American people to own some land, the ever-increasing price of land in the Middle West and the restless energy of the sons of pioneers of a section, contribute proportionately to the continued tide of immigration westward where land is to be secured at a reasonable figure. As the colonist crosses the range, his attention is drawn to the arid land, baking in the hot sun, or to the swamp land partially covered with water, yet possessing a fertility far surpassing the Nile and its deltas. Backward travel his thoughts to other lands from which only a modest bank account represented the wage of years of toil. Will it pay to heed the cry and try to wrestle from the arid soil a living or wealth?

Determined to enter the lists and convinced that the one essential is water, thought is given to its source, the magnitude of its supply, and how obtained. Will it be by following the old methods of gravity irrigation, or will the conditions of supply compel a system that will assure water when and where demanded and at a moments' notice?

Gravity System.

The farmer who has suffered repeated failure of crops suddenly awakes to the creek peacefully flowing through his land and hastens to construct a crude earthen breastwork to retain the flow and divert it through flumes, or ditches, over the parched soil, and noting the stimulus given the grain, advises his neighbor, who perhaps seeks the same source of supply, and soon the stream reveals, by reason of the heavy demand on it, nothing but a dry channel.

Knowing that the springs are inexhaustible, a company is formed and reservoirs are constructed at a great cost to retain the winter's floods that a supply of water is available for use in the summer.

The irrigation district, thus formed, is possible only by filings on the flow of the river and by each land owner purchasing a stock interest in the reservoir and the ditch proportionate to the amount of water demanded for his land. But repairs are necessary. The ditch must be strengthened, to prevent undue loss by seepage, and an assessment is levied on the farmer, year after year. Expensive when a comparison is made between the earning power of the land and the rate per acre assessment.

Hungrily others, promoters and farmers, gauge the flow of the stream, and through other filings construct huge canals to derive some profit from their land, diverting water from those who hold prior filings, appropriating their portion of the flow generously granted by nature, and claiming all the water originating in a territory as their heritage for gravity irrigation purposes. Another season of drought and restrictions are placed on the water and its use. The headgates are only opened certain days in the month and only a limited quantity of water is used for irrigating purposes, but still the assessments continue and the ditch, dry and parched, in the glare of the sun's rays, yields no water when needed.

To overcome this condition, a reorganization of the company occurs and other reservoirs are built to insure a steady supply of water for old established systems, seeking to overcome the increasing scarcity occasioned by the many filings on the water and the zeal with which more acreage is added to that at present under irrigation.

Cost.

Gravity irrigation usually involves the expenditure of at least $50 per acre investment in ditch rights, plus a maintenance charge of at least $1.25 per acre, or $4.25 per acre per year when interest is figured at 6 per cent.

Typical Gravity Irrigation Ditch.

On some projects, the cost per acre investment is as high as $100 per acre and the maintenance $1.50 per acre, a total charge per year of $6 per acre for water, the use of which is limited by the flow of streams, the requirements of his neighbors, the contour of the land and the location of the ditch, with reference to the high spots and the care given to the ditch to prevent undue seepage.

Water—A Potent Factor.

Irrigation by storage reservoirs and gravity has perhaps suffered more from the numerous fake land schemes, the promised development of irrigation systems which never materialized, the filing of claims on water already appropriated than by reason of construction defects. Yet, as irrigation is destined to become one of the most important, if not the most important economic factor of this country, will not water, where and when desired, become a potent factor in controlling the value of securities, of elections, and, in fact, act as a governor regulating the stability of the nation, due primarily to its necessity for the production of crops? Knowing the condition of crops to hinge largely on water and its supply, is it not therefore of vital importance to the nation that irrigation be accomplished in such a manner as to utilize, not alone the surface water, but the underground flow, removing the limits usually surrounding all but the most favored farms, drawing from the earth's storehouses, with electrically operated pumps, the liquid nature is "ready to serve"?

THE SIGNIFICANCE OF DEBT PAYING METHODS OF PUBLIC SERVICE CORPORATIONS.

BY F. K. BLUE.

If proper dividends, which are commensurate with the risk involved as indicated by the price offered for preferred stock when issued, have been distributed, the payment of the debts of a public service corporation out of a sinking fund will increase the market value of the stocks of the corporation, and so to that extent amounts to an unearned increment which is enjoyed by the shareholders at the expense of the consumers who have paid this amount to the corporation in excessive rates. This amount also represents a physical property value that was never obtained by cash actually invested by the stockholders.

Suppose 7 per cent on the market value of outstanding stock be the commercial appraisal of a straight investment in the properties and prospects of the corporation, and this amount is paid in dividends, and that eventually 3 per cent of such valuation is set aside for a term of years and is finally expended in the payment of a bonded indebtedness (this operation not having been anticipated in the offers for the original stock issues.) The payment of these bonds should then increase future earnings by the amount of interest saved, and therefore the market value of the outstanding stock should increase commensurately. So the whole transaction from an economic standpoint is equivalent to a payment of a 10 per cent dividend to the stockholders during this period, 3 per cent of which is reinvested in the property and prospects of the corporation. Although the number of outstanding shares has not been changed, the physical value of the corporation property which is represented by the outstanding stock has been increased and its earning power is greater. Two shares of common stock at 40 is, as far as investment is concerned, equivalent to one share at 80 when the same proportion of physical value and earning power is represented in each case. Although the nominal capitalization remains the same, the real capitalization has been increased, and the physical valuation upon which in a rate fixing suit the courts would award a "reasonable return on investment," has been increased by funds which were virtually distributed to the stockholders in the past in excess of a "reasonable return on investment." A sinking fund used in the retirement of bonded indebtedness may then be regarded for all practical purposes as equivalent to a payment of dividends to stockholders.

On the other hand, the payment of bonds by means of new bond or stock issues requires a new investment of actual cash from without, to replace a previous investment of cash. If the new securities are in the form of bonds, the economic conditions have not been altered, except that the conditions may be more or less favorable to the corporation in regard to interest charges. If they are in the form of stocks the nominal capitalization has been increased, but the real capitalization remains substantially unaltered. Before the transaction, the capitalization represented the physical value of the properties less the par value of the bonds. Afterwards, the increase in nominal capitalization represents the physical value formerly represented by the bonds that are now retired. If the return demanded on the stock is greater than the return demanded on the bonds, a surplus should have been accumulated to be applied in part payment of the bonds so that the market value of the stock would not be affected by the transaction, and the sale of the new issue at such market value would provide the remainder of the fund required to retire the bonds. The existing investors are thus protected against loss and the new investors come into the corporation on equal terms, while the consumer is not affected in any way by the transaction.

The payment of bonds out of a sinking fund is exactly the same from an economic standpoint as the investment of surplus in extensions and betterments, the practical difference lying only in the time at which the property is brought under the control of the corporation. In one case, such property, although under the control of the stockholders, is really purchased by the stockholders and not paid for by the stockholders until the bonds are retired by funds derived from earnings. In the other case, the property does not come under the control of the corporation until paid for by the stockholders by funds derived from earnings. Aside from the often erroneous attitude of the public, it is immaterial as far as economic values are concerned whether such property is represented by stock dividends to the stockholders or by a resulting rise in the market value of the outstanding stock already issued. In one case the stockholder enjoys his slice of "melon" in dividends on new stock of the same market value, while in the other case he gets it in the rise in the market value of his old stock due to the increase in the dividends on its par value, which results from the relief from interest payment on the bonds that were retired.

In cases where service rates are fixed by a commission or similar body, such application of sinking funds or surpluses is made really at the expense of the consumer, since he is thereby forced to pay a profit on property which he has himself already actually contributed, and which in the case of municipal purchase he would practically be required to pay for twice. Surplus reserves are valuable and necessary in strengthening corporation credit, balancing operating expense against fluctuating revenue, and maintaining uniform dividends, but they should finally be distributed as ordinary or deferred dividends, used in the purchase and retirement of outstanding stock of the corporation (rate reductions following), or applied to the credit of the consumer in the purchase of the property by the public. Such reserves should not be allowed to grow so large, however, as to result in the collection of wealth from the consumers of one generation for the benefit of the consumers of the next.

When service rates are invariable or are fixed by the corporations to conform to conditions of maximum profit, it makes no difference to the existing consumer whether the surplus reserves are distributed to the stockholders as dividends, applied in payment of bonded indebtedness, or invested in extensions and betterments, except when the rate conditions for maximum profit are altered or betterments affect his service at the same rates. In such cases the corporation can no more help changes in the value of its stock than an owner in the heart of a large city can

prevent changes in the price that may be offered for his lot. The unearned increment that may be enjoyed is of the same nature from an economic standpoint, and is no more blameworthy in one case than in the other. In both cases, the conditions were created or allowed by the public, and property rights and obligations were thereby established which should not in justice and in equity be invalidated or destroyed when changes in these conditions are found necessary to conform to the ever changing demands of progressive thought and action. Individuals should not be made to suffer from the social errors of the past and the penalties of adjustment should be borne by all in just proportion.

Let us never again try to force the whole burden of our errors and imperfections even upon those who have most profited by them in the past, and thus may we avoid such lamentable and appalling conflicts as divided our fair land just fifty years ago.

That the principles involved in those conclusions are becoming recognized by the courts is shown by the following citations:

15 I. C. R. R. 376, 415, by Commisioner Prouty, "During all this period the excess has gone into the property, which has gradually become more valuable, and this increased value has reflected itself in the market price of the securities of that company."

179 Po. 231, 46 Atl. 249, 251, by Judge Williams, "In determining the amount of the investment by the stockholders, it can make no difference that money earned by the corporation, and in a position to be distributed by a dividend among its stockholders, was used to pay for improvements and stock issued in lieu of cash to the stockholders."

212 U. S. 414, 29 Sup. Ct. 357, 53 L ed. 577, by Justice Peckham, "It certainly was not proper for the complainant to take the money, or any portion of it, which it received as a result of the rates under which it was operating, and so to use it, or any part of it as to permit the company to add it to its capital account upon which it was paying dividends to shareholders."

COMPETITION.

The accompanying illustration shows the unique condition of affairs at Port Townsend, Wash., where the Key City Light & Power Company operate both the electric and gas plants. In accordance with their progressive policy, they have placed large billboard

"God Is Light," but in Port Townsend It Is Recommended to "Cook With Gas."

advertisements "Cook With Gas" throughout the town. One of these happens to adjoin a small mission church which advertises "God Is Light." The conjunction of the two signs elicits much jocular comment from strangers. We are indebted to Mr. J. A. Kinkaid, manager of the company, for the photograph from which this illustration was made.

SAN FRANCISCO ELECTRICAL DEVELOPMENT LEAGUE.

The first meeting of the new year of the Electrical Development League was held January 14, President T. E. Bibbins, presiding.

After the transaction of the usual routine business, the League adopted the report of the code committee, appointed to confer with the department of electricity with reference to the proposed amendment of the building laws regulating the installation and maintenance of wires and cables used for the carriage of electricity for light and power. The amended rules will provide for the use of metal moulding or armored cable in electrical installations.

The time limit in which the proposed ordinance shall take effect was extended from 100 to 180 days. The meeting adopted the suggestion of Mr. E. B. Strong, western transportation manager of the National Electric Light Association, to organize and operate a special train to Chicago in June next, to be known as the "Golden Poppy Special" which shall convey the California delegation to the N. E. L. A. in that city, at that time.

The speaker of the day, Mr. J. R. Bibbins, resident engineer for Bion J. Arnold, traction engineer of Chicago, was introduced and told of the growth and development of San Francisco and its transportation facilities, the address being illustrated by stereopticon views of San Francisco and other large cities of the country.

The burden of the message delivered to the League was the absolute and pressing necessity for quick and determined action by San Francisco in making due preparation for the growth that is to come, by building extensions to its transit lines, by constructing tunnels to develop the immense acreage of attractive but unpopulated residence territory and secure the necessary intercommunication between isolated districts, and by working out a system of finance by means of which the present unsatisfactory relation between the city and its transit systems may be improved. In analyzing the growth and development of other cities as compared with San Francisco, Mr. Bibbins showed plainly that there was not the slightest cause for apprehension for the future, but rather that San Francisco occupies an enviable position among the large cities of the country with respect to the inherent possibilities of development through short-haul and high riding habit of its citizens. This fact, he stated, should make it particularly easy for this city to improve its opportunities and reach a satisfactory and permanent settlement of the perplexing questions now confronting it. The absolute inadequacy of the city's purchasing power for the acquisition or construction of utilities was emphasized, and results from other cities were drawn upon to illustrate the immediate response of underlying property values to improved transit facilities.

Mr. Bibbins showed the municipal boundaries as they exist have practically no bearing whatever upon the broad movements of population, but rather that rapid transportation and the geography of the district alone control these movements.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue. Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.

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Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1890.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electric Pumping Costs

Much discussion has appeared of late in the columns of the Journal relative to electrical pumping and irrigation. To the farmer, having under consideration the purchasing of a complete pumping installation, definite information as to costs is most essential. It is unfortunate that to date the farmer has often been mislead or misinformed on this vital feature with the result that he often finds himself embarrassed with bills totaling double the original supposed outlay necessary. Such, for instance, proved to be the case in the successful installation detailed in the leading article of this issue.

The dealer is not always wholly to blame in all such cases, for the farmer's ideas of plant size usually grow in magnitude as the calling for bids proceeds. It is seen that the additional costs of excavation, concreting, roofing and the like practically totals an amount equal to the dealers' figures for plant equipment and installation. Thus, on first sight, an installation of machinery costing $600 would hardly be thought to ultimately total $1200. Dealers should be careful, now that complete costs are known more definitely than formerly, to see to it that the purchaser is fully aware of the ultimate magnitude to which such installations will total.

Ths electrical pumping of water, though at present of vast proportions, is yet but an infant compared to its ultimate possibilities. Installations of to-day, permanently and successfully accomplished without misrepresentation, mean tremendous activities on the morrow for the dealer supplying the machinery and the contractor performing the installation.

The Los Angeles Aqueduct Power Problem

The citizens of Los Angeles are at present engaged in a heated discussion as to new bond issues and the proper disposal of the power to be developed in the course of conveying water through the Los Angeles Aqueduct from the Owens River Valley to the San Fernando reservoirs. The problem is one of interest, not alone to the people of Los Angeles and the three great power companies now supplying her needs, but since similar projects are even now being proposed in other great metropolitan districts of the West, it is hence of keen interest to Western engineers in general.

Briefly stated the situation in Los Angeles is about as follows: The Los Angeles aqueduct, constructed to date at a figure approximating $25,000,000, is capable of supplying sufficient water to develop at present about 35,000 electrical horsepower. By the chance happening of a rather remarkable series of natural reservoir sites along the line of the aqueduct as constructed, the water may be so controlled during the daily fluctuating period that the peak load conditions now prevailing in Los Angeles may be conveniently handled without auxiliary steam supply. This truly is unusual and gives the aqueduct development a distinct advantage over the companies now operating in that field.

It is proposed by the engineers of the aqueduct to retail this power in and about Los Angeles. By paralleling the present distributing systems, it is assumed that the present load of competing companies

may, at the wink of an eye, be shifted to the city's bus bars. Meanwhile, the power companies now serving the field have made a cold cash offer of $1,000,000 per annum as a wholesale purchase price for the 35,000 horsepower. Any additional power which may be developed along the aqueduct is to have its proportionate wholesale selling valuation. In accepting this offer the city of Los Angeles is not asked to give up its ambition of some day owning its utilities.

To the onlooker removed from the heated field of debate it is surprising that those having the best interests of the aqueduct at heart do not welcome this happy and timely solution of aqueduct expenses, for such an income as this is easily seen to be of sufficient proportions to approximately carry the interest on the present outlay of $25,000,000. On the other hand, the costly competition, the unrelenting and unkindly warfare against hitherto much welcomed servants of the people, the absolutely indeterminate costs of such a struggle and the ultimate re-duplicating of costly service equipment stand forth as ghastly ghosts which may perchance blight a project now receiving hearty commendation and support from engineering quarters the world over.

It would seem that the promoters of the Los Angeles aqueduct would content themselves for a season at least, in consummating the main object of their great municipal undertaking, perfecting the general scheme of operation, rather than whetting the battle axe for an immediate fray, when such a fiasco may reasonably be avoided.

Considered again from its economic side, which after all should be the fundamental basis of argument, the citizens of Los Angeles should themselves prevent reduplication of a costly distribution net-work. The surprising sight, which greets the engineering visitor, when inspecting for the first time the distribution system in Los Angeles, is the comparatively small amount of reduplication work which the present competing companies have themselves suffered to take place. In countless districts casual investigation shows that a competing company has not entered a field properly and adequately served by its rival. In those districts where competing lines have been instituted the remarkably efficient and economic system of combination poles impress the visitor that careful curtailing of expenses involved has always been kept in sight. Indeed this joint pole system, instituted only a few months back, has saved by its neat and unobtrusive workmanship much costly underground work which otherwise would have been a necessity. The fact that a saving of 35,000 poles in distribution has been effected is indeed a positive indication of this foresight.

To reduplicate equipment means a burden of $6,500,000 to be borne eternally by the citizens of Los Angeles. The saving in interest on this sum which will be accomplished by wholesaling means an additional annual expenditure of over $300,000 otherwise necessitated. The utility companies of Los Angeles are securely controlled by regulating commissions. No possible unjust charge can be made by them in retailing this power. As distributing agents acting under tightly bound regulating commissions controlled by its citizens, the utilities of Los Angeles can charge only what is just and reasonable. Putting aside countless arguments which may be presented in allowing the present servants of the people to continue to distribute their product under wise regulation, the fundamental law of economic operation—avoidance of costly reduplication—demands that the conservative two-thirds of the voters in Los Angeles try, for a season at least, the proposed scheme of wholesaling the aqueduct power.

Credit, the basis of the phenomenal growth of Los Angeles, is at stake. Her utility securities are now known the world over. Whether to jeopardize this credit should indeed be thoughtful food for the reflection of her citizens.

Water Power of Navigable Streams

Again the problem of water power grants confronts the nation. The world's greatest development at Keokuk, Iowa, wherein 300,000 horsepower are to be brought to life in the near future by the raising of the Mississippi River, is illustrative of the countless possibilities of the great Columbia and other powerful streams of the West. Hitherto Western engineers have sought comparatively high heads for the generation of hydroelectric power. The great slow falling rivers have been correspondingly neglected. Recent advance in low head power generating apparatus now makes possible the utilization of a drop through the turbine, formerly considered thoroughly impracticable.

The cry of the West is "Make ready the way for the coming of 1915." Improvement of Western national waterways is especially an emphatic necessity. In his recent message to congress the President has forcefully called the attention of that body to the need for immediate necessity of improving the methods in grants for water power development on navigable streams. The development of power and transportation intercourse must go hand in hand. The uses of the one are impossible without the other. That a portion of the income from power utilization may be made to pay for a reasonable improvement on the stream itself looking toward increasing navigation facilities on that stream is truly far-sighted statesmanship.

Indeed the construction of these dams of themselves materially aids in this great work. Most of the navigable rivers of the West are comparatively long and shallow. The slack-water or canalization method used in river navigation improvement has of late been proposed by many experts as being thoroughly sound. This method consists in building a series of dams and locks, each of which will create a long pool of deep navigable water. At each of these dams there is usually created also water power of commercial use. Such a chain of developments would certainly ultimate in the highest economic utilization of the rivers for power and navigation. Any enactment charging for the privilege of power generation of this sort, by private corporations or municipal undertakings, should specifically provide that no discrimination be made as to privately owned corporations versus the municipally owned. Furthermore, all moneys thus accruing should be put back into improving the uses of the particular waters whence comes this natural resource.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Thomas Mirk, of Hunt, Mirk & Company, has returned to San Francisco from Southern California.

Harry Hays came up to San Francisco from Visalia and attended the Electrical Development League meeting Tuesday last.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, is visiting Portland and Seattle.

James H. Mason, general manager of the Simplex Electrical Company, Boston, has left for an extended trip around the world.

J. R. McKee, A. D. Young and **Anson W. Burchard**, of New York, have been elected vice-presidents of the General Electric Company.

R. B. Mateer, representative of the Great Western Power Company at Sacramento, spent several days in San Francisco the first part of the week.

C. P. Rhodin, civil engineer with J. G. White & Company, is at Paisley, Ore., in connection with some reclamation work of which his company has charge.

J. B. Lukes, representative of the Stone & Webster Engineering Corporation, is expected to return to San Francisco from the East about January 25th.

E. M. Cutting, who has recently taken the Pacific Coast agency for the Edison Storage Battery Company, has established officers at 818 Mission street, San Francisco.

R. M. Alvord, manager of the supply department of the General Electric Company at San Francisco, has returned to his office after a two weeks' absence in Central California.

E. K. Barnum, who has been in charge of the construction of the Nisqually power plant of the City of Tacoma, has been appointed superintendent in charge of operation by **Nicholas Lawson**, commissioner of light and water.

H. A. Lardner, Pacific Coast manager for J. G. White & Company, was at Los Angeles during the past week. A surveying party is now at work on the new Tule River development of the San Joaquin Light & Power Corporation.

Heinrich Homberger, consulting engineer, San Francisco, has been appointed advisory engineer for hydraulic plant equipment by the Oro Electritc Corporation in connection with the proposed 40,000 k.v.a. power plant on the north fork of the Feather River, California.

H. W. Soderling has resigned as manager of the Wenatchee Valley Gas & Electric Company to become vice-president and sales manager of the Bliss Electric Company, at Wenatchee, Wash. His successor is **Louis Shreve**, formerly assistant manager.

M. L. Scobey, of the Pacific States Electric Company, was married to Miss Sue Agnew January 15. The newly-weds have left San Francisco on a week's honeymoon trip. Congratulations to Mr. and Mrs. Scobey, and may the future have many years full of happiness and contentment in store for you.

R. H. Dearborn, professor of electrical engineering at the University of Oregon, at Eugene, has been appointed consulting electrical engineer to the Railroad Commission for the State of Oregon. This commission's powers have been increased to include supervision of all public utilities in the state.

F. W. Hild, general manager of the Portland Railway, Light and Power Company, returned from Los Angeles to San Francisco this week, and will return to Portland on Sunday While at Los Angeles he addressed the Electrical League.

E. G. Allen, superintendent of construction Stone & Webster Engineering Corporation, Seattle, Wash.; **Wm. J. Davis, Jr.**, engineer Pacific Coast district General Electric Company, San Francisco, Cal., and **H. Y. Hall**, assistant electrical engineer Southern Pacific Company, San Francisco, Cal., have been transferred to the grade of member in the American Institute of Electrical Engineers.

A. H. Babcock, electrical engineer for the Harriman Lines, San Francisco; **O. B. Coldwell**, general superintendent of the Portland Railway, Light & Power Company, Portland, Oregon; **R. F. Hayward**, chief engineer and general manager of the Western Canada Power Company, Ltd., Vancouver, B. C.; **C. W. Koiner**, general manager and electrical engineer Pasadena (Cal.) Municipal Light Department; **F. D. Nims**, electrical engineer Western Canada Power Company, Vancouver, B. C., and **J. D. Ross**, superintendent of lighting, Seattle, Wash., have been transferred to the grade of Fellow in the American Institute of Electrical Engineers.

MEETING NOTICES.

Idaho Society of Engineers.

The Idaho Society of Engineers will hold its annual convention at Weiser, February 20, 21, 22 and 23. Subjects of papers and discussion will be Pumping for Irrigation, and Road Construction. On the last day mentioned an excursion will be taken down the Snake River to Homestead, Oregon, giving the engineers an opportunity to visit the gypsum plant, below Huntington, the Oxbow tunnel and power plant, near Homestead, and several mines in that vicinity. It is estimated that over 100 members will attend. The officers are: D. G. Martin, Idaho Falls, president; A. E. Robinson, state engineer, Boise, vice-president; Edward Hedden, Caldwell, treasurer; Ira Shaffner, Boise, secretary.

Spokane Jovians.

C. R. Bean, Jovian statesman for Washington, advises that Jovian lunches were held at Spokane on December 10 and 24th.

The luncheon on the 10th was presided over by V. G. Shinkle, purchasing agent for the Washington Water Power Company. Mr. Loomis, illuminating engineer of the H. W. Johns-Manville Company, gave an instructive talk on illumination, illustrating his remarks by means of various shades and various lights. Mr. Wilson, oil engineer for the Galena Signal Oil Company described the matter of lubrication as applied to electric railway rolling stock and hydroelectric generating stations. The luncheon on December 24th was presided over by H. G. Peterson, and talks were given by Fred Caldwell, chief engineer of the Independent Telephone interests in Eastern Washington, Montana and Idaho, and by Mr. Loebell, commercial engineer of the Spokane Falls Gas Light Company. Mr. Caldwell's talk was on the automatic telephone system, going into the construction, operation and maintenance of the modern commercial telephone. Mr. Loebell described the manufacture and marketing of gas, and also new apparatus which will be put on the market this year. The interest in the luncheons seems to be increasing, as over forty were in attendance. On January 14th, Mr. Bean will preside. The policies of the Jovian Luncheon Club for 1913 will be discussed.

Portland Section, A. I. E. E.

The next regular meeting of the Portland Section of the A. I. E. E. will be held at the clubrooms of the Oregon Technical Clubrooms, 247½ Stark street, Portland, Oregon, at 8 P. M. January 21, 1913. The paper of the evening will be presented by Professor W. A. Hillebrand, professor of electrical engineering, State Agricultural College, Corvallis, Oregon, the subject being "Transformer Connections."

Portland Jovians.

The "Jovian Electrical League" luncheon took place as usual at the Hazelwood at noon, the 9th, about forty being present. J. B. Middleton of the Home Telephone Company, gave a brief talk, outlining the ideals of the Home Company. He said his company welcomed state regulation, as it protected them against the Bell interests in many cases where they could not protect themselves unless they had a commission to appeal to.

Mr. Burnett Goodwin is chairman for the month of January.

A "Publicity Secretary" was elected, the honor falling upon Mr. "Ole Olson" of the Fobes Electrical Supply Company.

After this date no more postal card notices will be sent out, but it is to be understood that the Jovian Electrical League luncheon is a permanent affair, and will be held at noon every Thursday at the Hazelwood Restaurant. Speakers of general interest will be obtained for every meeting.

Oregon Technical Society.

The first regular Oregon Technical Club luncheon of the new year was held at the so-called offices of the commission, Portland Hotel Rathskeller, on Tuesday, January 7th, at 12 noon. All members of the Oregon Society of Engineers, Portland Architectural Club, American Institute of Architects, American Society of Civil Engineers, American Institute of Electrical Engineers, National Electric Light Association, American Society Mechanical Engineers, were called upon to attend this session of the commission, when bids were opened on the "Sullivan's Gulch Canal Project." Estimated cost of this work, $37,000,000. Several fake contracting corporations were on hand to submit bids, and for a "stunt" luncheon it was one of the best ever enjoyed here.

Subsequent luncheons will be held as follows, under the auspices of societies mentioned: January 14th, A. I. E. E.; January 21st, Portland Architect Club; January 28th, M. E. L. A.

TRADE NOTES.

The Boston office of The Cutler-Hammer Manufacturing Company moved from 176 Federal street to larger quarters in the new Columbian Life building the first of the new year.

The firm of Otis & Squires of San Francisco has been dissolved. H. B. Squires will continue the business as H. B. Squires Company. W. I. Otis will be identified with several Eastern manufactures.

The Simplex Electric Heating Company has added a fourstory addition to its factory at Cambridge, Mass. It is planned this increase of space will merely allow expansion of the congested quarters to a comfortable working condition, and does not provide for expansion necessary to take care of further normal growth of the concern's business.

The Oakland, Antioch & Eastern Railway Company of San Francisco, has ordered from the Westinghouse Electric & Manufacturing Company one quadruple equipment of No. 308B-6 and Type HL Control for use on an electric locomotive. This is a duplicate locomotive ordered by this company several months ago which is now in operation. The locomotive is designed for operation on either 600 or 1200 volts direct current. The Santa Barbara Consolidated Railway Company, Santa Barbara, Cal., has ordered ten double equipments of No. 337-C-3 motors and RLF control.

The Greenwood Advertising Company, the largest manufacturers of individual electric signs in this country, has recently determined on the establishment of a factory in California. The plant will be located at Los Angeles and it is expected to have same in operation by the first of February. The home concern is located at Knoxville, Tenn. Both factories will have the same management and inspection by the National Board of Fire Underwriters and Label System. Mr. A. Greenwood is president of the company and Mr. J. E. Zucker, vice-president and general manager, with offices at 211 Blanchard Building, Los Angeles.

NEW CATALOGUES.

Bulletin No. 2 from the Automatic Flagman Company of Los Angeles, Cal., attractively portrays the manner in which their signal protects grade crossings on steam and electric railways, giving combined visual and audible warning for both night and day operation.

The Engineering Department of the National Electric Association has recently issued Bulletins 8D and 10c. The power is devoted to Mazda miniature and low voltage lamps, including lamps for automobile, general battery, novelty battery and similar uses. The latter is concerned with Mazda train-lighting lamps, showing the performance and characteristics of lamps designed for steam railway use.

Westinghouse Box Frame Commutating Pole Railway Motors Nos. 317, 317-A, and 317-A2 are thoroughly described and illustrated in descriptive leaflet No. 3511, recently issued by the Westinghouse Electric & Manufacturing Company. Folder 4245 covers the Westinghouse Universal Blow Torch, which is adapted to all conditions of service. A cross-section view of the torch illustrates its working parts, and the little folder describes the mechanism in detail. "Saving the Tires Without Fire" is the title of a little folder describing the automatic tire vulcanizer manufactured by this company. Particular emphasis is laid on the fact that no fire is required, and therefore tires can be vulcanized in the garage without any danger.

The General Electric has recently issued Bulletin No. A4065, describing its various types of Polyphase Induction Motor Motors. Bulletin No. A4069 is devoted to the subject of Portable and Stationary Air Compressor Sets. Bulletin No. A4066 illustrates Electric Hardening Furnace. Bulletin No. 4994 describes and illustrates Subway Transformers. These supersede previous bulletins on this subject. Bulletin A4065, the 1913 Catalogue of Electric Fans, is an attractive publication of 36 pages, in colors, and it illustrates fixed and oscillating desk and bracket fans for alternating and direct current, and also ceiling fans and ventilating fans, The publication contains also illustrations of various wiring devices for use in connection with fans as well as a list of supply parts for all fans.

BOOK REVIEW.

"The Distribution of Gas." By Walter Hole. 837 pp., 5½x8½ in.; leather bound. Published by John Allan & Co., London, and for sale by Technical Book Shop, San Francisco. Price $5.00.

The appearance of a third edition of this treatise in less than six years is conclusive proof of its value as a text-book for the student and a hand-book for the manager. The text is divided into thirty-seven chapters, dealing with every phase of the subject. The new edition has been thoroughly revised and many additions made to care for recent developments in illumination, heating and combustion. The library of every gas man is incomplete without this volume.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

MUNICIPAL INSPECTION.[1]

BY HOWARD JOSLYN.[2]

Municipal inspection of sanitary and structural work done by individuals with the object of protection to life and property, has grown largely in the past decade. As towns and villages grow to be cities efforts of this kind follow as part of the advanced police powers given to the corporation by its citizens.

Muncipal inspection of buildings and all pertaining thereto is apt to seem over done to those who are effected by the stringency or difference of the regulations over methods to which they have been accustomed. Prejudice of this character may continue for a long time, unless the inspection departments are careful in their dealings with citizens to point out reasons for their work being kept to certain standards.

You have all doubtless seen some of the numerous statements comparing property losses from fire in the United States to those of other countries; apparently much to our discredit. There are undoubtedly causes for this great annual loss which can be remedied to greatly reduce the same; but it must be admitted that conditions of rapid and enlarged construction in this country have some bearing upon the results. Everywhere is manifest the ambition of our people to quicken the pace, to centralize in cities; and following such centralization to erect high buildings and utilize to the utmost a small ground space. Of all the agencies assisting man in the speeding up progress within the past generation, electricity can easily be called the foremost. Its use, however, is not an unmixed blessing; and unless properly conducted for its purpose it may prove an engine of destruction.

Having perceived these conditions the genius of man has endeavored to make plain all things which should be guarded against in the use of this valuable force. Early manifestations of its destructibility as a fire hazard naturally brought it most prominently to the attention of those whose business is chiefly affected thereby; that of insurance. As an outgrowth of much study and effort we have an electrical code providing rules and regulations for the installation of electrical equipment in and about buildings. To ascertain the extent to which their regulations are carried out, those interested in the insurance business naturally have inspectors. All such inspection, however, has been guided by their business rules; and, although it has accomplished great good, yet its extent has not been sufficient.

Realizing all this, cities of the highest class have found the principal method of betterment thereof in establishment of an inspection by the municipal government. It is, however, with great credit to the engineers who made up the electrical code, that municipal regulations for installing electrical equipment follow closely the rules established by the code. Its many rules are really the application of a few broad principles to govern work with a great complexity of details; and criticisms of the code are generally based upon its application to details of some particular work on some one or few specified occasions.

Some municipal ordinances differ slightly from each other and from the code; and considerable discussion of this matter has brought forward advocates of some plan by which the wiring regulations of all cities can be made alike. It is apparent that general action of this character can best be brought about by the Federal Government acting upon broad lines to create standards of construction and materials to be used. Some effort already made in this direction has shown that much time will probably elapse before anythig definite can be accomplished. Meanwhile considerable good is being done by conferences between inspectors, representing different cities, in their association meetings in various parts of the country.

To obtain knowledge of all work done is the first object of the inspection department; and, to this end, practically all city regulations require that a permit must be taken out before beginning the work. The charging of fees for issuing permits or for making wiring inspections is based upon two reasons, either for revenue to meet expense of inspections or as a penalty to command greater attention to the necessity of obtaining a permit for work to be done. The charging of fees for revenue is objected to by many as being a charge upon the individual for the benefit of many; but on the other hand it is argued that the owner of the property wherein the work done is being inspected is the one immediately benefiting thereby. Advocates of the fee as in nature of a penalty must also answer the argument that the proper penalty is one to be inflicted after commission of error and not as a notice in advance to refrain from it.

The city of Seattle has recently passed an ordinance abolishing all fees for wiring inspection to take effect January 1, 1913. The amount of fees collected there since beginning the work in July of 1910 has been sufficient to more than meet the expenses of the inspection work by about ten per cent. It is feared by some that without revenue from fees efforts made by subsequent administrations to reduce expenses may result in cutting down the number of inspectors below that actually required for the work; but this is still a matter of conjecture.

After the permit is issued, it is distinctly the duty of the contractor or wireman doing the work to report same to the inspector when ready for inspection. Neglect on his part to do this promptly may not only cause much embarrassment to the owner but also annoy the inspection department through its receiving undeserved criticism as being the source of troubles arising therefrom. City ordinances should properly give to the inspector the right to remove obstruction, such as lath and plaster, in order to view the work; and while the giving of notice of preparedness for inspection rests with the wireman yet there should also be some remedy for prevention of undue delay upon part of inspector after receiving such notice. Corrections found by the inspector should not only be left in a statement at the work, but should be sent by mail or otherwise to the wireman; who in turn should proceed promptly to make the required changes and again call it up for inspection. The observance of these principles of action on the part of both contractors and inspectors marks a long step forward in the line of successful municipal inspection.

The past decade has witnessed rapid advancement in construction and material for installing electrical equipment. At first wiring was done as open work, then in concealed knob and tube work and in wooden moulding, to be followed by the use of rigid and flexible metal conduit with accompanying refinements of materials and more economic methods of construction. The natural desire of all owners to save money is not often modified with an ambition to secure the best and most durable installation. Keen competition between contractors and wireman for work generally results in their sug-suggestion of economies in cost; all of which try to lesson the standards of work recommended by the inspection department. To reduce the possibility of misunderstanding it is the best policy to define the city regulations within what districts or in what classes of building certain methods of installation must be used. Some cities now require all wiring to be in-

[1]Paper presented at Annual Convention Oregon Electrical Contractors' Association, Portland, December 17, 1912.

[2]City Electrical Inspector, Seattle, Wash.

stalled in metal conduit; some require metal covering altogether in certain specified districts; some require it in structures other than of wood; and the general tendency is to eliminate altogether the use of wooden moulding and greatly reduce the extent to which open work may be applied; concealed knob and tube work being best adapted to residences.

Seattle requires that wiring in practically all buildings other than of wood and in all buildings for storage and warehouse purposes shall be encased in metal conduit or moulding; also that all cabinet boxes shall be of metal; and all services installed in conduit. Parallel with these regulations is the one now very general, that all conduit or metal moulding should be carefully and effectually grounded, the exception to which requirement should only be allowed by the inspector in cases of very short pieces of conduit which do not come into contact with combustible material or are not in a location where liable to contact with persons. Another regulation for general safety should preclude the installation of current carrying equipment within reasonable reach of grounded contact, such as the installation of metal sockets or switches close to bath tubs, lavoratories, etc.

The Underwriter's Laboratories at Chicago, with their thorough tests of wire insulation and other electrical equipment in accordance with the construction rules of the National Code, have been almost universally adopted as a standard of reference for electrical material and appliances acceptable to municipal inspection departments. With no desire to criticise their admirable work, yet with a desire to improve local conditions, one or two cities are conducting their own tests of electrical equipment used within their municipal limits. Unless a central testing laboratory is so established that its decisions will be taken by the courts when such decisions are established as binding by city ordinance it is highly probable that an action in law contesting the same, brought by a capable attorney, would result in decisions adverse to the inspector.

Another consideration presents itself in the difficulty for distant cities to obtain prompt knowledge of appliances accepted by the Underwriter's Laboratories; and for the inspector to be positive that its distinguishing marks of approval are authentic. Until present conditions are changed, it therefor seems advisable that municipal inspection departments on the Pacific Coast, and in other places distant from Chicago, should be equipped for determining whether or not electrical appliances and material comply with the construction rules of their ordinances. As a beginning of such work it would be well to at least equip the departments for testing insulation of various kinds of wire. Simple tests by measurement and otherwise can also be conducted for determining qualifications of other material and appliances.

One question which has arisen since passage of the amendments shown in the 1911 edition of the Code is in regard to the stretching tests to be given rubber insulation of wire several months after its receipt from the factory. It is claimed by some that the stretching test for new wire should not be applied to rubber insulation when it is several months old but yet has not been in service. The plea is made that for such rubber insulation the lower stretching test of 4 and 5 inches should be used. The latter argument, however, is not good because of the indeterminate factor of age of insulation, to be sure of which the inspector must have absolute knowledge of the wire from its time of manufacture until it is put into service. This would involve much additional work for inspection departments, reaching beyond geographic limits of their jurisdiction; and the general plan has been to require that rubber insulation of all wire used must meet the stretching test specified for new wire. The lower stretching test should be regarded as applicable for determining quality of insulation upon re-survey after the wire has been in service for a period not exceeding one year.

The rules for general wiring of the several classes are doubtless too well known to require discussion in detail at this time. Municipal ordinances should express the rules and regulations in a clear and concise manner making their meaning plain and positive. Nothing can create more trouble for the most conscientious chief inspector than a large discretion allowed him under regulations which state that one or more methods may be used subject to his approval. His approval in such instances will undoubtedly, after a time, result in establishing precedents which will conflict thereby causing almost endless confusion. In work with so much detail there cannot but exist one or two points where the inspector's approval is really the basis of the rule; but this should only occur when absolutely necessary.

Much confusion may arise from interpretation of the rule of 660 watts as constituting the load upon a branch circuit. With a desire for economy wiring is often laid out with the view to not only restricting the outlets, but also the number of circuits by specifying one or more 16 c.p. lamps capacity to the outlet. How often it is the case when the architect or wiring contractor's plan is followed that a re-survey several months after the wiring is put into service will find one or more branch circuits over-loaded? This trouble should be promptly met by the chief inspector setting a reasonable limit upon the number of outlets per circuit and preferably requiring a diagram of the work to be submitted in advance. The general rule in Seattle is to establish 8 outlets as a maximum for branch circuits in residences, and 6 outlets for branch circuits in business houses. All of this, however, is subject to change after inspection of plans or diagrams of the wiring which are required to be filed with a large portion of the applications made.

Determining the capacity of main and sub-feed wires should be done by the inspector on the basis of branch circuits with consideration of the average load. The public service corporation furnishing light and power will generally place the size of its service mains at far less than could possibly be considered for main feeds by the inspection department. They do this for economic business considerations which are foreign to the fundamental idea of the large factor of safety upon which inspection regulations are founded. It is the duty of the inspector, however, to base his estimates upon a reasonably safe amount of average load; and the sizes of wires demanded to reduce the voltage drop to two volts will not often be lower than the general table of allowable capacity for rubber insulated wires. In residences, hotels, office buildings and apartment houses 75 per cent of the amount obtained by multiplying the number of branch circuits by six amperes should afford ample safety in fixing capacity for main and sub-feeds. In stores, theatres, churches and places of public gatherings the percentage should be one hundred or very close thereto.

It is universally recognized that the carrying capacity of rubber insulated wires is safely more than that established by the table in the code and in general use by inspection departments. The standard of inspection set by some municipal departments is such that the allowance of larger capacities would be safe but wisdom would not be shown in making this change generally because of the lack of comprehensive and authoritative inspection by many towns and cities. Any further steps of this kind will be largely brought about only by the betterment and increase of municipal inspection. One change, however, which might be allowed is the increase in size of fuses to ten amperes for branch circuits. This size of fuse is generally used in replacement after the work has been approved by the inspector; and it is well within the safe capacity of No. 14 gauge wire.

Municipal inspection departments should be given full authority over all electrical appliances installed and used in theatres and places of public gathering; and such supervision should extend over the persons employed to care for and use such equipment. Motion picture operators should be carefully explained and their work allowed by suitable license revocable on their failure to carry out regulations of the depart-

ment. A conscientious inspection of the same will then almost eliminate accidents or losses due to electrical hazard.

The field inspector shoudl have as one qualification a comprehensive experience as a wireman in various grades of the work. Without going into detailed instruction for benefit of some amateur workman, the inspector's practical knowledge is often of greatest importance in discussion of details with the contractor. There are very few lines of work possessing such a variety of detail, and many cases arise wherein the regulations must be interpreted in the light of common sense and practical experience. Few inspectors have not met with the old contractor or wireman of long experience who did work before the code was established, and who really in his own opinion knows more than the man who wrote the rules. Should such wireman be of an obstinate disposition, heated discussions will frequently arise between him and the inspector. This is one instance where the municipal ordinances, if properly drawn, are far superior to the code when used as a reference by inspectors, either insurance or muncipal. Field inspectors should never be permitted to indulge in a heated or forcible argument with the contractor or workman upon the job. The inspector should simply state that he is there to look the work over and all arguments should be taken up with the head of the department. When such cases are brought to the attention of the chief inspector, if he has the right kind of an ordinance, he can politely but firmly show the futility of questioning the established regulations, stating that changes therein can only be made by legislative authority.

Criticism is sometimes made by contractors that the field inspector has made unfavorable comment to his customer about the work. Some instances of this kind may have been true, but it will generally be found, with a sensible man as inspector, that the statements attributed to him have been largely put into his mouth from the thoughts of the customer. Some people will probably always be found who will endeavor to "beat the game"; and they are not over scrupulous even in so small a matter as "standing off" the contractor or wireman for his pay on account of alleged faults or inspectors' statements which have really not been made. It is generally not the inspector's duty to state that a fixture is hung too low, or that the shades are not of the correct size, or that the finish of the wiring cabinet is not in harmony with the style of furniture, etc. Criticisms of this character are apt to justly detract from the standing of the inspection department which can in such instances reasonably be told to mind its own business. The training of field inspectors should cover all matters of this kind with the object of obtaining capable and common sense supervision of the work done.

With the advancement of the application of electricity, there is another action toward guarding the interests of the owner or customer which has not, as yet, been widely taken; viz: that of safeguarding the people against the misrepresentations and sometimes rascality of irresponsible wireman and socalled contractors. Ordinances should be passed by cities and, if necessary, laws by the state legislature fixing an examination for all wiremen by which they may obtain a license to do work; all of which may or may not be accompanied by a responsible bond. Many property owners have been persuaded by cheap prices to let the wiring contract to a workman who, after collecting as much money as he can on the work, will run away and leave it far from a condition in which it would pass inspection. The added burden upon the owner in such cases often bring the cost of the work to a greater sum than if the work had been done by a responsible contractor. The remedy for these conditions is not hard to obtain by intelligent and concerted action on part of the responsible wiremen; and when once put into force it will go far to elevate the trade and secure to it the respect which it deserves.

COSTS AND EFFICIENCY.

BY P. L. PROCTOR.
(Concluded.)

Floor No. 1.

Wire plus time, plus direct expense, plus indirect expense, equals cost of wiring Floor No. 1.

Pipe plus time, plus direct expense, plus indirect expense, equals cost of piping Floor No. 1.

It will be readily seen that were estimates to be kept on file in this detailed manner, and the cost records kept to conform to it, the executive would soon locate his weak points in making estimates, and by careful examination of each day's work he would readily see whether or not the estimate in any particular unit and the profits anticipated on it were going to be realized. You will readily agree with me, I think, that such information is invaluable, for it gives a reliable basis of argument, should the contractor find it necessary to urge his men to "speed up" in order to break even on any particular unit of the work.

The distribution of indirect expense or burden has become the subject of much discussion and debate by many cost experts. Many theories have been advanced from time to time by some of our leading production engineers and cost accountants, as to the distribution of indirect expense, but it is as much open to discussion at the present time as it ever was.

At this time we are only interested in the method that best fits the requirements of the contractor, and after much thought I have come to the conclusion that the distribution of burden by the time plan is the one that is more adaptable to his needs. A summarized explanation of this method is that every productive man in the employ of a company must bear his pro rata of indirect expense of that company. We will take an hypothetical instance.

You are called upon to make an estimate of a job. Your overhead expense or burden amounts to $12 per day; there are 12 productive men in your employ, therefore each man will bear $1 overhead expense per day.

Your estimate will read as follows:

Material	$25.00
Time (1 man 1½ days at $4.00 per day)	6.00
Overhead expense (1 man $1.00 per day—1½ days)	1.50
Cost of production	32.50
Profit 25 per cent	8.12
Amount of estimate	40.62

You will see that by this method the overhead expense practically adjusts itself automatically to a fair amount per productive man. A large increase in productive men generally means a proportionate increase in unproductive men, and, on the other hand, a reduction in the productive force means a proportionate reduction in the unproductive force. At the same time there are certain fixed charges that a reduction in the productive force would not affect, such as rent, light, heat, office expense, etc., and in this case the executive must use due discretion, and must, by careful examination, ascertain where he can reduce his overhead cost so as to bring it down to a standard whereby he can render satisfactory estimates, and still assure himself of profit.

A cost system which comprises the information I have just referred to is the first step toward efficient management.

To build up a successful business one must not only know the trade or profession in which he has started, but he must be prepared to meet his competitors and start on a level which it has taken them years to attain. In order to do this he must not only familiarize himself with the principles of costs, but he must, each day, watch his business with an eye which has keen analytic powers. Clinton E. Woods of New York City, who is considered one of the ablest practitioners of costs, says that a business is a living, breathing, moving being, which has an anatomy peculiar to itself, but which can nevertheless be analyzed in its every func-

tion. It is the duty of a manager of any business to grasp and interpret his business conditions by units. I am sorry to say that book keeping is only tolerated by many business men. It is charged up as a loss, and the expression, "If I could only cut down my office force," crude as it may seem to many of us, is by no means uncommon. This class reminds me of an Egyptian mummy. A mummy's only asset is its age, and the only emotion it inspires is one of wonderment that it has lasted. Three-fourths of the business failures are mummified businesses. If they had been galvanized into new life before it was too late, they would be still doing business on a sound basis.

I have remarked that account keeping was only tolerated and I will venture to say that half of the business men in this country do not use their records enough to become acquainted with the invaluable information they possess. Account keeping for precedence sake is worse than no account keeping, for the man who keeps no accounts obtains the same information, which is nil, as the man who keeps accounts for precedence sake, and at less cost. If you are going to keep accounts and are employing an office force to keep them for you, do not let this department become a loss to your business. If it be used in the manner for which it was intended, namely, to give reliable facts of business transactions, it would become one of the most profitable departments in your organization.

Another principle which is absorbing the minds of our eminent business men is the relationship which should exist between employer and employee. A contractor's profits rests in the efficiency of his workmen, therefore it should be the employer's foremost thought. There is a lot of unnecessary dignity which is impressed upon the mind of the employe by the employer. This has an unwholesome tendency to widen a breach which is already dangerous between these two classes. Capital makes labor and labor makes capital, therefore the two existing because of this relationship should be brought together in practical harmony. An employer should learn to understand his men and acquaint himself with their efficiencies and inefficiencies. Hiring and firing are indiscriminately practiced without study and discretion. All business men have different ideas of conducting their business and when an employe has been in one man's service a little while he becomes a capital investment and not as a movable commodity. There are many ways by which an employe can be interested not only in the work which he is employed to do, but in the company at large, for it is the organization which has the co-operation of all its employes that, undisturbed by turbulent feelings of its workers which in so many cases is the ruin of many, forges steadily ahead and pays dividends on an inexpensive investment of courtesy.

In closing, I would urge the electrical contractors of this country to follow the example of the printers by appointing a cost committee to draft up a cost system, which will be applicable to your needs, and which can be cut down or elaborated on to suit the business of every contractor, be it large or small.

WILL RAISE VOLTAGE.

The British Columbia Electric Railway Company is contemplating the alteration of its transmission system on the lower mainland of British Columbia and the provision of an improved central service covering its large territory in that section. At present the company's transmission lines, carrying 40,000 volts, run from the generating station on the North Arm of Burrard Inlet to substations at Burnaby and Vancouver, at which points the current is stepped down and distributed. The company's new plans as tentatively announced contemplate the erection of a large receiving station near Esmond avenue, Burnaby, along the route of the Burnaby interurban line. Current will be sent to this station from the North Arm power house at 60,000 volts and connections established from the central point with the various substations, a loop system being formed so that alternate sources of power will be available at each point in case of accident to any part of the lines. The plant of the company, while not complete as to detail, are said to involve the reconstruction of the present pole lines from Lake Buntzen, equipping the line with 60-foot poles carrying metal cross arms and disc insulators of the suspended type.

CORRECTION.

The latter part of "Exhibit F" in F. D. Weber's paper on "The Relation of the Oregon Electrical Contractor to the Underwriters' Inspection Work in Oregon" as published in this journal on December 14, 1912, was omitted. In order to make this report complete the following data should be added:

Index of Deficiencies.

10. Attics not properly bored and bushed.
34. Service conduit must extend to main line cutout or into cabinet if same is required.
50. Flexible cord not standard.
51. Flexible cords too long (a) or used other than as pendants.
52. Flexible cords in show windows.
55. Portable lamps, motors, fans or fixtures not connected through reinforced cord.
58. Pendant cord attached to circuits without approved fittings.
59. Unapproved cord adjusters.
60. Cord circuits.
63. Pendant cord used for outside wiring not approved.
101. Wires attached with wood cleats, staples or nails.
131. Loose fittings.
172. Service wire bushed with flexible tubing; must be porcelain or conduit.
211. Fixture canopies on top of circuit wires or pendant switch wires.
230. Installation in such a hazardous condition that same should be completely re-wired.
272. Miniature light wiring not approved.
360. Lamp receptacles with exposed lugs or contacts in show window.
392. Entrance switch improperly located (a) or not readily accessible.
396. No sub-base under snap switch (a) or receptacles.
430. Lamp sockets not bushed.
495. Wires in contact with outside awning (a) or with metal front or side of building.
497. Wires not bushed (a) or bushed improperly through walls, floors or partitions.
498. Wires of opposite polarity through one hole.
500. Wires not attached rigidly in position (a) or loose from support.
503. Wires not supported at sufficiently frequent intervals.
508. Wires in contact with other materials than insulators.
509. Unapproved wire.
515. Bare wire.
516. Wires knobbed (a) or cleated over flat surfaces.

Your "special attention" is called to the defective installations in the following risks, thirty days or more having elapsed since owners were advised:

Party Responsible.	Class.	Street.	Defects.
		West side Main Street.	
W. F. Matlock..823-815	B	Blk. 1, sh, 7, p. 33, r. 12	10, 34, 55, 58. 60, 63, 392, 430, 495, 508, 509, 515, 516.
Tom Malarkey ..749-755	B	Blk. 3, sh. 7, p. 34, r. 2	50, 51, 52, 55, 59, 60, 101, 131, 172, 211, 230, 360, 392, 396, 497, 500, 508, 509.
Chas. Brownfield ...745	B	Blk. 3, sh. 7, p. 34, r. 8	52, 172, 500, 508, 516.

Defective installations were found to exist in the following risks, and the owners have been advised:

		West side Main Street.	
Jesse Failing ...901-903	D	Blk. 317, sh. 7, p. 33, r. 2	230.
W. F. Matlock ..837-851	B	Blk. 1, sh. 7, p. 33, r. 6	172, 211, 272.
W. F. Matlock ..829-831	B	Blk. 1, sh. 7, p. 33, r. 10	52, 58, 101, 172, 498, 503, 508, 516.

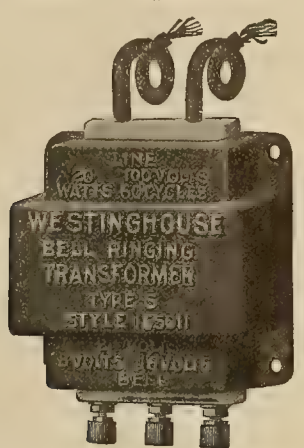
Moving picture machines are improperly installed in the following risks, to which your "special attention" is called:

		West side Main Street.	
Swartz & Greenlick (Pastime) 610	B	Blk. 353, sh. 16, p. 35, r. 10	Booth not standard.
J. P. Meternock (Orpheum)	—	Blk. 323, sh. 16, p. 35, r. 10	Booth not standard.

INDUSTRIAL

TYPE S BELL-RINGING TRANSFORMER.

The use of bell-ringing transformers has become so popular that the Westinghouse Electric & Manufacturing Company has placed on the market a new transformer of this type. The fact that it possesses such characteristics enables it to be mounted in any out-of-the-way place, as it requres no attention whatever after its installation, and should last a lifetime, and will deliver on open circuit, 8, 16 or 24 volts,



Type "S" Bell Ringing Transformer

and, fully load, 16 volts. The coils and iron are completely embedded in a fireproof and indestructible compound, which precludes any possibility of the bell-ringing circuit coming in contact with the 110-volt circuit.

In testing a current of 2500 volts for one minute is applied between the primary windings and the secondary winding and case. The transformer will stand a "dead" short circuit continuously on the bell-ringing side without injury.

RECENT POWER INSTALLATION.

An interesting installation of high-tension power equipment is that in the new flouring mill of the Wasco Warehouse Milling Company at The Dalles, Oregon. This mill represents the best of modern mill construction, not alone in electrical apparatus, but along all lines of machinery, buildings, etc. The main building is seven stories high and approximately 170x80 feet ground space, built entirely of reinforced concrete and steel. The present capacity is 1300 barrels per day, and the ultimate capacity will be 2750 barrels per day after the last unit is installed.

The power equipment consists of General Electric, three-phase, 2300-volt induction motors of the following capacity, which will be duplicated with the installation of the last unit of the mill: Main drive, one 300-h.p, 2300-volt Type P motor; cereal mill, one 15-h.p., 2300-volt motor; barley and graham mill, one 50-h.p., 2300-volt motor; wheat receiving, one 35-h.p., 2300-volt motor; wheat scouring, one 35-h.p., 2300-volt motor; wheat scouring No. 2, one 15-h.p., 2300-volt motor; flour packers, one 15-h.p., 2300-volt motor; feed packers, one 15-h.p., 2300-volt motor; Humphrey elevators, two 3-h.p., 250-volt motor; automatic sprinklers, one 5-h.p., 250-volt motor.

The wiring and installation of power and control apparatus was carried out with the view of continuous service and ease of handling. The control of all motors is centralized on a switchboard located in a separate room especially designed for the purpose, the switchboard consisting of eleven standard panels, 24x72 in., mounting all oil break, overload switches with relays, etc., each switch being equipped with signal lamps, enabling the attendant to see trouble that might occur in any portion of the mill.

The compensators, except the main drives, are located at the motors, and these are, of course, equipped with no voltage protection, and are all mounted on steel frame hangers especially designed for the concrete columns nearest their respective motors. All compensators were ordered and designed for conduit entrance, and all outlets are either potheaded or enclosed in steel enclosures. The conductors to each motor in the building are entirely separate circuits, and no two motors are dependent on any one set of protective apparatus, with the exception of the main oil switch, which controls the entire load of motors. The conductors all consist of multiple, 5000-volt, lead-encased, varnished cambric-insulated cables, drawn into galvanized conduit buried in the concrete during the construction of the building.

All motor frames are, of course, grounded, as well as is the entire conduit system, the lead sheath of the cables, and all metal parts of all switches, compensators, etc., are ground separately as extra precaution, and as a protection to operators and to the system.

The various power circuits terminate at the switchboard in a terminal trough built of heavy angle iron and No. 10 gauge steel, and this box is equipped with heavy fibre brackets grounded separately as extra precaution, and as a protection to other circuits in case of trouble on any one line. From this terminal trough the various circuits are extended down in conduit to the switch terminals and potheaded directly above each switch.

All protective apparatus is provided with separate potential transformers, so that the failure of any one device does not in any manner hinder the continuous operation of the balance of the mill during repairs.

From the above description it will be readily appreciated that there is not an exposed current carrying live part of any of the apparatus, which fact eliminates all possibility of accident to employees, and insures almost continuous service so far as the motors are concerned.

The lighting of the mill consists of approximately 200 porcelain Benjamin reflector sockets of 16 in. diameter and 100-watt Mazda lamps, giving an efficient distribution of light over the entire area of each floor. Beside the regular lighting there are numerous receptacles provided for attachment of extensions in case of repairs, examination of machinery, etc.

The power and lighting installation was designed and installed by the West Coast Engineering Company of Portland, Oregon. The building was designed by Bennes & Hendricks, architects of Portland, and power is furnished by Pacific Power & Light Company.

AUTOMOBILE ELECTRIC VULCANIZER.

The Westinghouse Eletcric & Manufacturing Company have recently placed on the market an electric vulcanizer which can be used on either direct or alternating current circuits, for automobile repair purposes.

The vulcanizer is provided with a concave surface for use in vulcanizing the casing or shoe, and a flat surface, which is used for the inner tubes. This is a great time and trouble-saver, and lessens the actual work connected with vulcanizing.

The process of vulcanizing requires from 15 to 45 minutes, depending on the cut and the part to be vulcanized. In the repairing of an inner tube, the patch is placed on the tire and then clamped to the flat surface of the vulcanizer. It is essential that the vulcanizer be brought to a temperature of about 275 degrees before applying, and that this temperature be maintained throughout the process. The temperature is controlled by a rheostat and read by thermometer on the clamping board.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—American Conduit Wiring Machine Company; $250,000, shares $1 each, subscribed $5; by I. and L. Hirshfeld, G. S. Johnson, F. G. Fox and A. J. Wright.

ILLUMINATION.

VALLEJO, CAL.—The work of installing electroliers on George street will be done by the city.

CORVALLIS, ORE.—The city of Corvallis is considering the advisability of owning and operating an electric light and power plant.

WENATCHEE, WASH.—A municipal lighting and power plant is the next undertaking of Wenatchee, and already steps are being taken to this end.

RICHLAND, ORE.—If present plans materialize there will be an electric plant built in the near future for the purpose of lighting Eagle valley.

COVINA, CAL.—Plans and specifications have been ordered prepared for an ornamental lighting system to include Center, Badillo and Citrus avenues.

REDLANDS, CAL.—The Southwest Electrical Company of Redlands has been awarded the contract to install an ornamental lighting system in the business section, on its bid of $9698.

LOS ANGELES, CAL.—Sealed bids will be received up to January 20th, for furnishing and installing the necessary equipment, also electric current for lighting Hyde Park Lighting District.

WILLOWS, CAL.—The Glenn county supervisors have granted upon the application of Lawyer Harmon Elbery the petition of the Oro Light & Power Company for a franchise to operate in this city.

RIDDLE, ORE.—Richard N. Hall of Glenbrook Farm has plans for installing a hydroelectric plant with the waters of Rail Creek as a source of power for light and power purposes. The plan is having the consideration of engineers connected with the Fairbanks Morse Company.

SAN BERNARDINO, CAL.—Sealed bids will be received up to February 24th, for a gas pipe franchise, granting permission to lay and construct a system of pipe lines in, under and along certain streets and public places in the city, for the purpose of supplying residents with gas for lighting, heating and other purposes.

TRANSMISSION.

NEW WESTMINSTER, WASH.—The Canadian Western Lumber Company here will erect a new power plant and install a 1875 kw. low pressure turbine.

EUGENE, ORE.—The Oregon Electric Railway Company are preparing plans foı development of the Clear Lake power project in the Cascade mountains, east of here. When completed the plant will develop 30,000 h.p.

TACOMA, WASH.—A franchise for a high tension power transmission line between this city and Dieringer to bring power from the Lake Tapps power plant has been granted by the county commissioners to the Puget Sound Power company.

KELSO, WASH.—Commissioners of diking district No. 1 are working on the proposition of constructing a power plant to generate power from the falls on Coal Creek, using the same to operate pumping stations within the Mount Solo diking district. Work will begin as soon as possible.

COLUSA, CAL.—Application has been made by the Oro Electric Corporation for a franchise to erect, maintain and operate lines for transmitting and distributing electricity in the county of Colusa, over certain routes, highways, etc. Sealed bids will be received up to February 4th.

TACOMA, WASH.—The Tacoma Railway & Power Company, L. H. Dean, general manager, contemplates spending between $500,000 and $1,000,000 on the Electron project next year. The erection of practically 10 miles of new flume and a large portion of tunnel work is included in the improvements.

PHOENIX, ARIZ.—Work is to begin at once on the high tension line from Roosevelt dam to Maimi and Globe for supplying of power and light to mines and towns. The line will be capable of carrying 45,000 volts, and will be of suspended transmission. Steel towers with concrete foundations similar to those used on the Roosevelt-Phoenix line will be used.

AMERICAN FALLS, IDAHO.—The American Falls Power Company has completed a concrete dam 1500 feet long and 12 feet high across the Snake river at American Falls, Idaho, and is now ready to install the necessary equipment for a new hydroelectric plant which will develop 4000 h.p. A. J. Wiley is the company's chief engineer, who is represented in Boise by J. L. Savage.

MOUNTAIN HOME, IDAHO.—The Crane Falls Power & Irrigation Company is installing a hydroelectric plant of four 3000 h.p. units. The transmission line will be built from the plant to the Gem irrigation district, situated on the south side of the Snake River, 16 miles west of Caldwell. Electric pumps are to be installed at Nampa Ferry and at Homedale. Smith-Kerry & Chase, Boise, are the engineers who have in hand the installation of the pumping machinery and the delivery of the water. As the Crane Falls plant will not be ready for service for a year or more, the plan is to acquire power elsewhere next spring, so as to supply water to the land for the 1913 season.

SAN FRANCISCO, CAL.—That it may complete the construction of the great dam and reservoir at Big Meadows and provide for new equipment and extensions, the Great Western Power Company has applied to the railroad commission for permission to issue first mortgage 5 per cent 40 year gold bonds to an amount sufficient to yield $3,971,731. Following are the purposes for which the company would put out the large bond issue: Distribution, lines and service connections to consumers, to care for new business, $709,195. Construction of transmission tower line, 15 miles from Moraga valley to the south side of Carquinez straits, substation at Carquinez terminal of line; transformers, etc.; new armored cable under San Francisco bay; auxiliary line from Napa to Santa Rosa; second circuit from Carquinez straits to Napa; new armored cable beneath the waters of Carquinez strait; 4000 kw. motor generator set at Fruitvale, etc., $362,602. Extension of Big Bend power house by completing installations of units No. 5 and No. 6, $639,627. Completion of Big Meadows dam and reservoir, $1,075,800. Acquisition of lands in Big Meadows reservoir site, $200,000. Other additions to property, $23,819. Reimbursement for moneys expended on Big Meadows lands, $679,905. Reimbursement for moneys expended for plant additions, $280,783.

TRANSPORTATION.

HUNTINGTON PARK, CAL.—Victor G. Kleinberger has been granted a franchise to construct and operate a single or double track electric street railway in this city.

MEDFORD, ORE. — The M. P. McInney Realty Company, a $1,000,000 concern of Oakland, Cal., are applying for an interurban electric trolley line franchise in this city. If the franchise is granted work will begin within 90 days.

OREGON CITY, ORE.—Mark Woodruff, an official of the Portland, Eugene & Eastern Railway Company, is authority for the statement that work on the line from Portland south will be commenced in the spring. Approximately 40 miles of line will be built.

ORANGE, CAL.—Notice has been given the Board of Supervisors that the Pacific Electric Company has petitioned for a permit to construct a trestle across the entrance of Alamitos bay for the extension of its line between Long Beach and Bay City.

LOS ANGELES, CAL.—A petition, bearing the signatures of 1500 persons, asking for improved car service on the West Jefferson street line, has been presented to the city council. A double track is urged from Arlinton to Fourth, which now contains only a single track. The petition asks that the line be extended to the city limits at Ninth avenue and also double tracked.

SAN FRANCISCO, CAL.—The Board of Works has taken action to have the public service corporations remove prior to February 11 their manholes, conduits and other underground structures from the line of the municpal railway tracks which are to be laid on Market street, between Geary and Sutter, so that there may be no delay in the construction of these tracks after the work is started.

STOCKTON, CAL.—Negotiations have been completed for the purchase of $750,000 worth of Tidewater & Southern Railway bonds by J. W. Goodwin, president of the Oro Electric Corporation. The railway company, which is now operating two trains a day between Stockton and Modesto, will be in a position now to complete its electrical equipment and continue its line to Turlock. The bonds which the Oro Company has purchased pay 6 per cent.

PHOENIX, ARIZ.—President C. C. Lewis of the Salt River Valley Electric line, known as the "White Line," has asked for a right-of-way over the county roads between Phoenix and Mesa, via Tempe. The route of the White Line leads east on Van Buren street to the city limits, thence north one-half mile, thence east to Salt River. The line will cross the river on a bridge which will be constructed east of all the bridges now constructed, or in course of construction, by the company itself. Work is expected to start about February 1.

OAKLAND, CAL.—In an effort to induce the Oakland & Antioch Railway to make good its promise to establish an Oakland terminal depot near the downtown business district, a committee of the Merchants' Exchange will confer with the management of the railway. When the promoters of the Oakland and Antioch Railway began operations in Oakland four years ago, the leading spirits in both the Merchants' Exchange and the Chamber of Commerce agreed to lend their influence in the securing of rights of way for the new road with the understanding that the terminal should be established within six blocks of the Oakland City Hall.

SAN RAFAEL, CAL.—The third-rail electric system of the Northwestern Pacific will give way to the overhead trolley between San Rafael and San Anselmo within a short time, according to an announcement made here by railroad officials. Work of double tracking the line between those points has been started. It is reported that the railroad company will apply to the trustees of San Rafael and San Anselmo at once for permits to replace the third-rail with the trolley system, and that it is also the intention of the company gradually to do away wtih the former throughout its lines in this county. It was also announced that the Northwestern Pacific is planing a much improved service between San Rafael, San Anselmo and Fairfax.

WASHINGTON, D. C.—The Great Falls Power Company, of Montana, has been granted permission to transmit over public domain under strict government regulations, power for the electrification of 450 miles of track of main line of the Chicago, Milwaukee & Puget Sound Railroad between Harlowtown, Mont., and Avery, Idaho. The grant, which is for 50 years, was worked out under the act of March 4, 1911, relating to electrical transmissions, telephones and telegraph lines. The grant is subject to readjustment every 10 years, provides for regulation of rates and service, the sale of power to the United States, the states and cities at as low rates as is given any other buyer, and prohibits the transfer of the permit without the approval of the Secretary of the Interior.

TELEPHONE AND TELEGRAPH.

SOLEDAD, CAL.—The residents of the Mission District have installed a telephone line which shall be known as the Mission Rural Telephone Company.

FORSYTHE, MONT.—The Forsythe telephone as a local institution went out of existence January 1st, becoming a part of the Mountain States Telephone Company's system in this State.

ELSINORE, CAL.—The Southwestern Home Telephone Company has been granted the right to erect and operate a telegraph, telephone, electric light, heat and power line in and along the public streets of this city.

SAN FRANCISCO, CAL.—An initiative petition bearing 10,000 signatures has been filed with Registrar Zemansky calling for an election on a proposed ordinance which provides for reductions of telephone rates ranging from 15 to 20 per cent lower than those now in force. The election commission has 10 days in which to verify the signatures, after which the supervisors must order an election to be held within 30 days after such order is made. A general cut of practically all telephone rates, including business, professional, residence, extension, private branch exchange and coin machines is proposed in the ordinance which the petitioners present. The bill would also require all telephone companies to file with the supervisors and mayor a complete inventory of their entire physical property.

WATERWORKS.

SAN FRANCISCO, CAL.—Bids have been called for by the Exposition Company for the installation on the exposition grounds of a high pressure water system and a water service system. The bids will be open until January 28th and the terms of the contract will call for the completion of both pieces of work within from six to nine months. The high pressure system will be used for fire protection alone, and the service system for domestic purposes. The high pressure system has been planned with a view to safeguarding all property and buildings on the exposition grounds to the utmost. It is expected to make arrangements with the city authorities whereby the exposition system can be connected with that of the city. The hydrants on the exposition grounds will differ from those in use in the city in that they will all be below the surface of the ground and access will be had to them by raising a manhole cover. An auxiliary arrangement is planned so that the fireboats may be able to pump into the pipes. In all the high pressure system will be about 9½ miles long, with a pipe six inches by sixteen inches. There will be 180 hydrants so distributed that only 600 feet of hose will have to be laid in any portion of the grounds. The service system will consist of about 12 miles of four by twelve inches pipe. This system will also be connected with that of the city.

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Johns-Manville Co., H. W.
Pierson, Roeding & Company
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Regulators, Boiler Feed
"Copes,"Moore & Co., Chas. C.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

Searchlights
"Dayton," Elec. Agencies Co.
Fort Wayne Electric Works
General Electric Company

Separators, Steam
"Stratton," Moore, Chas. C. & Co.
Pittsburg Piping & Equip. Co.

Shades
Benjamin Elec. & Mfg. Co.

Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
"Freeman," Elec. Agen. Co.
General Electric Company
Pacific States Electric Co.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.

Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.

Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.

Surveying Instruments
Post Co., The Frederick

Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.

Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Steel Castings
Columbia Steel Co.

Street Cars
"Brill,"Pierson, Roeding & Co.

Switches, Float
General Electric Company
Westinghouse E. & M. Co.

Switches, Disconnecting
General Electric Co.

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, 159 New Montgomery
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 578 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Moloney Electric Co.
San Francisco, Rialto Bldg.

Moore, Chas. C. & Co.
San Francisco, 99 First
LosAngeles,AmericanBnkBldg
Seattle, Mutual Life Bldg.
Portland, Wells-Fargo Bldg.
Salt Lake City, Atlas Bldg.
Tucson, Arizona.

Nason & Co., R. N.
San Francisco,151 PotreroAve.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific States Electric Co.
San Francisco, 131 N. Montgy.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 523 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 703 Spaulding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco,MonadnockBldg

Post Co., The Frederick
San Francisco, 135 Second

Safety Ins. Wire & Cable Co.
San Francisco, 589 Howard

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
LosAngeles, Union Trust Bldg.

Tracy Engineering Co.
San Francisco, 461 Market
Los Angeles, Central Bldg.

K-P-F Electric Co.
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.
Switches, Push Button
"M. & M." Elec. Agencies Co.
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Pacific States Electric Co.
Tel. Protectors and Terminals.
"Cook," Elec. Agencies Co.
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Towers, Steel.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Tubes and Bushings
Ohio Brass Company
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Moloney Electric Co.
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Holabird-Reynolds Co.
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
"Chapman," Moore & Co., Chas. C.
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee,"Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Pierson, Roeding & Company
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co.,The
Okonite Company, The
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles. 1758W.Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco. 141 Second
Weston Elec. Instrument Co.
San Francisco,682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

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POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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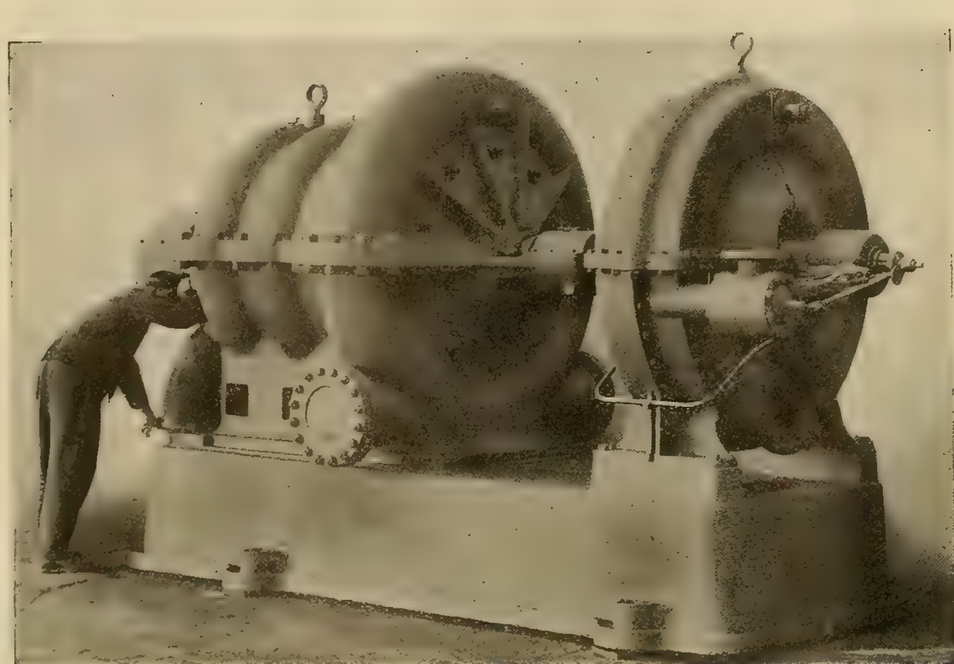

JOURNAL OF ELECTRICITY
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VOLUME XXX | SAN FRANCISCO, JANUARY 25, 1913 | NUMBER 4

A MODERN ELECTRICAL SUPPLY HOUSE

Much interest is attached to the manner in which the electrical needs of a great territory are served, not only in the supply of current, but also in furnishing the apparatus appliances and supplies which utilize that current. The great distributing center of the Pacific States Electric Company recently completed at San Francisco, offers an example of the most modern methods in receiving and distributing electrical appliances and of the application of scientific management to the conduct of a large business. As it embodies the latest ideas and most advanced practice, it seems worthy of the careful investigation given in the following description:

The building, a six-story and basement structure, is situated in the heart of the electrical and mechanical district of the new San Francisco on Mission street, between First and Second, running through to Minna, where all goods are received and dispatched. The exterior finish of light pressed brick with inlays of tile, gives a harmonious tone of gray which is at once unobtrusive and in keeping with this character of mercantile establishment. The exterior, walls, foundations and piers are of brick, laid in rich cement mortar and the floors and columns of mill (or slow burning) construction. Steel is used in the front and rear walls to admit maximum light and avoid heavy piers, the spread of the piers varying from 6 to 7½ ft. square, that of the wall foundations being 4 ft.

General View of Office Floor With Plate Glass Partitions.

Protection against fire has been so carefully planned that this mill type building enjoys one of the

lowest insurance rates on record for such a class of building. The building rate of 0.144 amounts to but $72.00 premium per year on $50,000. In addition to a most complete system of automatic sprinklers, there have been installed hose standards, chemical hand extinguishers, fire buckets, portable fire-resisting excelsior wagons, Pacific auxiliary fire alarm boxes, American District supervising sprinkler alarm and night watchman service, as well as local night watchman registering stations. All exposed steel work is covered with concrete and every architectural precaution has been taken to prevent fire. The automatic sprinkler system has close to 1000 sprinkler heads protecting all areas. These are supplied by a six-inch main line controlled in the basement by main cut-off valve and variable pressure alarm valve. There are also cut-offs and drain valves on each floor. This system has four possible independent sources of water supply, which consist of one 14,000 gallon gravity tank, two pressure tanks each of 5250 gallons capacity, a 3 in. special connection to the Spring Valley Water Company's main and lastly a two-way Siamese steamer connection for the supply of the fire department. The air compressor and feed pump are in the basement together with a 500 gallon surge tank. The system is direct connected with the storm water main so that it can be drained with facility for repairs.

The entrance vestibule on Mission street is marble-lined and provided with two sets of self-closing double acting doors, to keep out the wind and dust and leads directly to a passenger elevator serving the building.

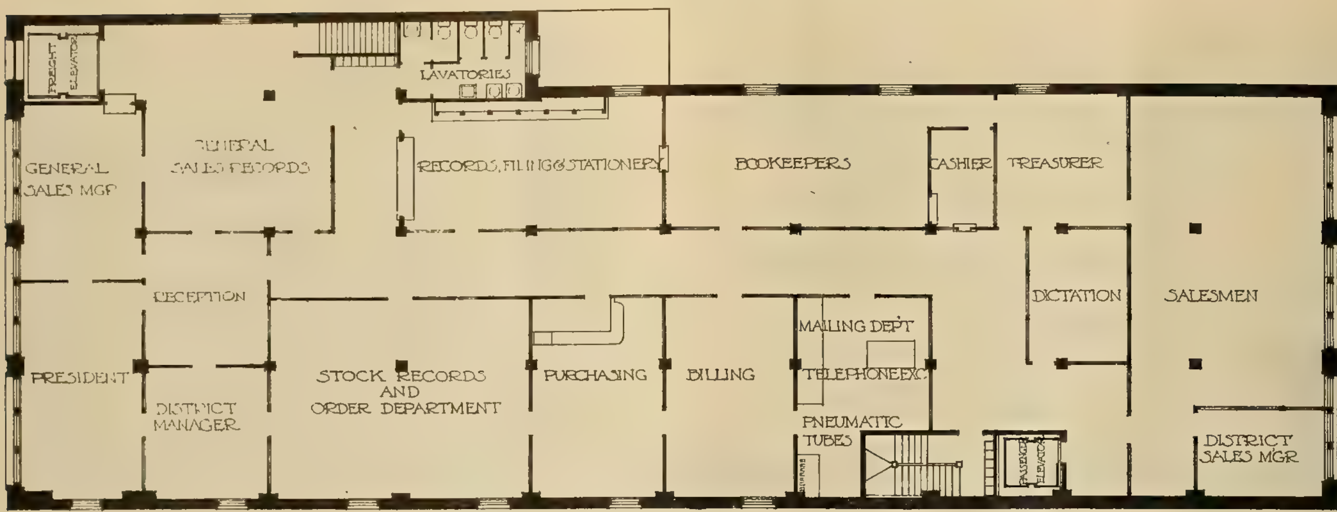
The local salesroom or store is to the right of the main entrance on the first floor. Here is stationed an attendant whose duty it is to direct customers to the several departments, as the policy of the company forbids the use of individual names or titles on doors or desks, the purpose being to accord equal treatment to all. He also has supervision of the counter salesmen and calls reinforcements when necessary.

Local Sales and Display Room on First Floor.

By raising the first story 3 ft. above the street level, the whole store has the effect of a show window, effectively used to display a great variety of electrical household apparatus. By this means, likewise, the receiving and shipping platforms at the rear of the building are thus raised to automobile height for loading and unloading. Further advantages of this innovation include the admission of ample light and ventilation to the basement, a 10 ft. clearance for piling rigid iron conduit, and natural drainage to both ends of the basement in case of flood, as well as raising the floor well above the highest tide water level.

In addition to the usual sales counter, shelving and drawers, the store is furnished with special glass

Executive and General Offices on Fifth Floor.



Plan of Executive and General Offices.

counters to display high grade heating appliances. For expeditiously handling the counter sales, pneumatic tubes are installed to carry orders to the several departments and an electric lift is provided to insure quick delivery from the stock floors to the store.

An attractive illumination has been secured by the use of Veluria Urnolites, a new artistic type of opal glassware, enclosing General Electric Mazda lamps. When cold, these units have the appearance of carved Italian marble. Though less than one watt per square foot is used, the resultant illumination is excellent and of high efficiency.

The executive and general offices are on the fifth floor, and embody several unique and distinctive features. The offices and corridors are separated by clear plate glass partitions extending from the ceiling to floor. This, together with the fireproof plate glass windows and light pearl gray wall finish give an abundance of natural light and a most cheerful appearance. This also enables the entire force to be viewed at work from any point on the floor, a feature planned to enlist the confidence of the public.

As the president's office is also used as a directors' meeting room, it alone has been provided with curtains which may be drawn to avoid interruptions during directors' meetings. All doors are equipped with door checks and stops and those leading into hallways have transoms. The cashier's office and the

Girls' Rest Room.
Dining Room.

Sprinkler Tanks.
Building Exterior.

Sun Porch.
Electric Kitchen.


Views of Apparatus, Display Room on Fourth Floor.

filing record and mailing list room are the only ones on this floor equipped with locks. These rooms are provided with counters and through which the employes may receive their information or records. None but those in charge of these departments are allowed to enter. Enclosed cabinets for all boxes, stationery and correspondence give a neat appearance. The general arrangement of the office is shown in the accompanying illustrations and plan. Each department is provided with a specially designed portable wagon to convey records from the office to the vault in the basement and to avoid the necessity of employes carrying papers and boxes.

The electrical installation on this floor offers several novel features. The main feeders are carried from rigid iron conduit to National metal molding with push button switches. The base-boards are provided with two race-ways, one for bell and telephone wires, the other for electrical conduit. All bells and buzzers are concealed in the base-boards in standard wall boxes covered with ordinary push button switch plates, the sound passing through the holes in the switch plate. Pockets have been provided in room base for the ready insertion or withdrawal of wires, thus avoiding the necessity of tearing up any woodwork.

In addition to the regular telephone service of the Pacific Telephone & Telegraph Company, a Kellogg inter-communicating system has been installed throughout the building, there being 19 desk set stations in the various offices and 4 wall sets in the stock rooms. All telephone wiring is concealed, the lead covered cables carrying the various circuits being brought from the floor through special iron pedestals supporting the key box, which is flush with the top of the desks. A portable desk set is placed upon the office table or desk. This inter-communicating system allows eleven different conversations at the same time without interference, or if desired, all stations can be connected for one general conversation. Any number of stations can be connected simultaneously. By using the auxiliary system, it is possible to obtain information from other departments while holding the asking party over the outside toll lines.

The offices are lighted by bowl type Veluria reflectors carrying General Electric Mazda lamps. This eliminates all glare due to the plate glass partitions and although only .7 watts per square foot is used, the illumination is perfectly diffused and is as near to daylight as is possible to obtain.

In the executive offices, a pleasing and efficient variation of the general scheme has been obtained by the use of single unit fixtures equipped with satin finish residence type Holophane reflectors.

Edison phonographs are used for dictation, operating from base-board receptacles on 110 volt direct current, while the lighting on this floor is 110 volt alternating current.

The girls' rest rooms on the sixth floor are an example of the care with which the welfare of each individual employe is considered by the company. Here is a beautiful reception hall with an adjoining dining room and electric kitchen for the exclusive use of the women employes. The entrance is from the main passenger elevator, thus providing direct communication to their quarters. An individual metal locker is provided for each girl. The rest room is beautifully furnished with Crex grass furniture, finished in brown to match the walls and draperies. It is fitted with base-board receptacles for portable lamp, vacuum cleaner, and inter-communicating telephone. The lighting is by four light clusters equipped with Holophane Iris shades. The dining room of large seating capacity opens directly to a sun porch protected from the west winds by a glass and steel screen. This sun porch is planked for the accommodation of chairs and rockers, while the remaining portion of the roof is provided with a six-ply asphalt and gravel roof laid over roof boards 3 in. thick, thus providing space for general recreation. The kitchen is equipped with a General Electric D 2 range, finished in white enamel with full nickel cooking outfit, including percolator, tea kettles, water heater, samovar, toaster, radiant grill, flat iron, hot plate and chafing dish. A set of white and gold china as well as silverware is also provided.

The display room on the fourth floor contains a complete exhibit of electrical apparatus, with provision for demonstration. Every article is tagged at the retail selling price so that the room may be used by contractors and dealers in showing apparatus to their customers and making their sale direct if they so de-

Views in Stock Rooms, Showing Box System.

sire. This room, like the general offices and the girls' rest room is wired with metal molding and condulet outlets. The illumination is similar to that in the offices.

The stock rooms are situated in the basement and on the first, second, third and fourth floors. Each floor and basement is in charge of an assembler and assistants. For assembling orders, the equipment of each floor comprises four-wheel truck for 1½ ton loads, dolly wagons for ½ ton loads and fibre boxes of various sizes for smaller articles. Each floor is under lock and key and no one but the assembler and assistants are permitted to enter it. The stock is charged to the assembler, who keeps duplicate stock cards as against the general stock cards, so that in the event of shortage he can prove his own delivery.

The stock is classified and arranged on each floor so as to facilitate delivery. Miscellaneous stock is carried in boxes resembling the standard built-up book case arranged in various sizes according to the nature of the stock, this excellent scheme being the result of the experience immediately following the San Francisco fire when other means could not be obtained. The lighter apparatus is carried on the upper floors and the heavy material on the first floor and basement. Portable electric lifts have been provided for stocking of heavy cases and barrels.

Suitable quarters have also been provided on the third floor as a lunch and reading room for the male employes.

The wiring of the building was planned for purposes of demonstration as well as for utility and a different equipment has been installed on each floor for inspection by architects, engineers, contractors and others, the whole building thus constituting an excellent display of electric construction methods. In addition to the equipment already described, the rear of the fourth floor and all of the third floor is equipped with galvanite conduit with Sprague boxes and pendant switches. The second floor is equipped with BX Greenfield flexible steel conduit, Greenfield flexible armored cable, Sprague outlet boxes and pendant switches. The first floor is wired with American conduit and condulets, pendant switches being provided in the rear and push-button switches in the store. The basement is wired with American conduit and Sprague boxes, the light being controlled by pendant switches. General Electric wiring devices and rubber-covered wires were used throughout the installation.

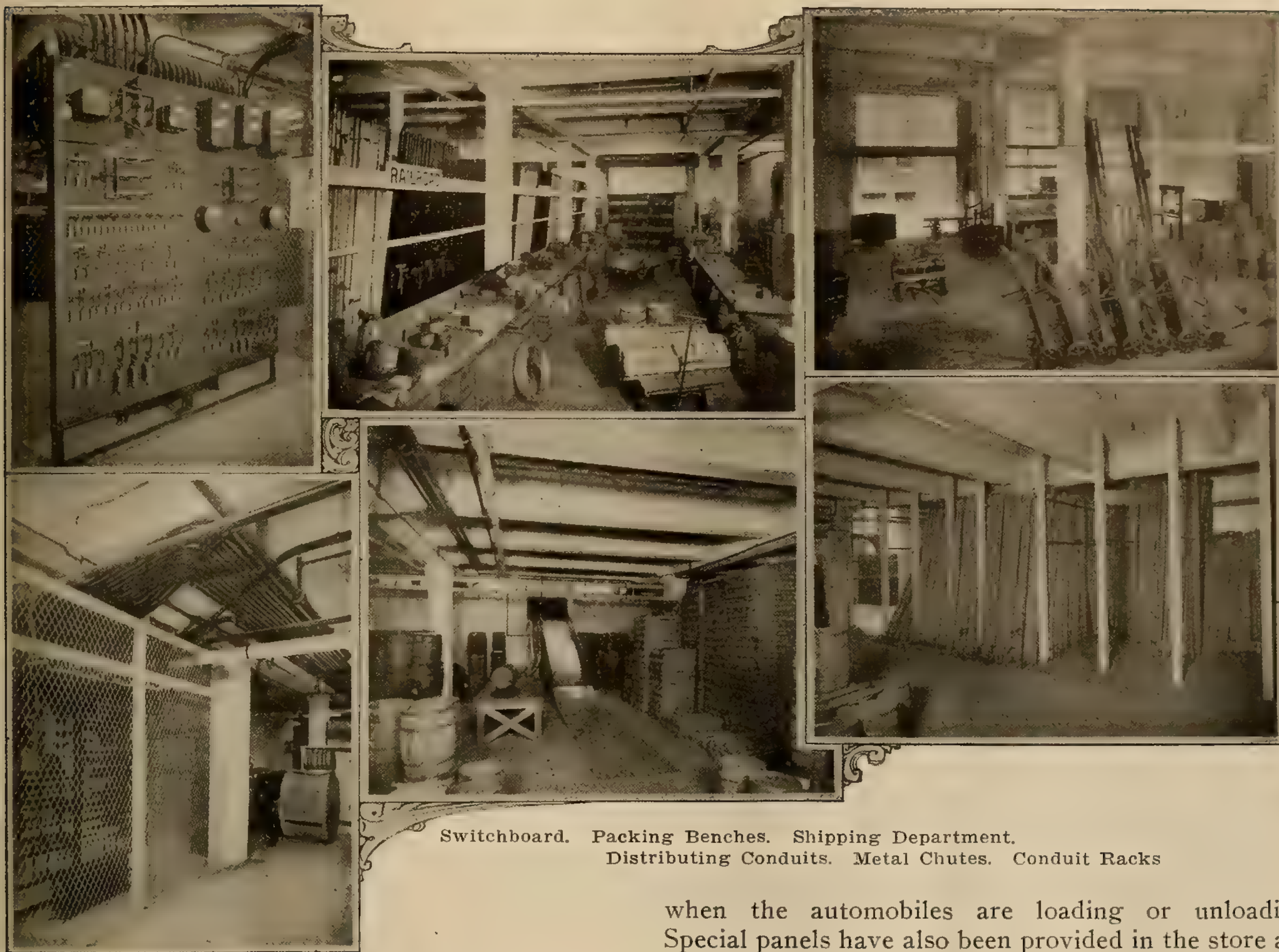
The shipping and receiving departments, as well as service office, are situated at the rear of the first floor. The orders, after being assembled on the various stock floors are sent to the main shipping room either by freight elevators or electric lifts, and upon reaching this floor a red alarm lamp advises the man in the shipping room that the material is ready to be distributed to the assembling benches, where provision is made for shipments by railroad, express, boats, city deliveries and city call orders.

The usual assembling bench has been adopted; but instead of the usual division and numbering scheme, the benches are divided into imaginary 1 ft. sections each foot of space properly numbered and division strips provided, so that assemblers take as little space for the assembling of each order as required and addition to or removal from assembling bench does not disturb the serial number of the other orders.

When the order is in the process of assembling one copy is always left in the assembling bench so that the man in charge of the shipping department knows at all times to whom and where the material is to be shipped. Immediately the assembling is complete, the assemblers place an additional blue ticket into the bin, indicating that the order is ready for shipment.

So as to facilitate the packing of goods and eliminate unnecessary handling, the old style packing bench has been abandoned and each packer provided with an ordinary hand truck on which boxes are placed and material taken from the assembling bench direct into packing cases. When the work is completed, the box remains on the hand truck until conveyed to the scales where all outgoing shipments are weighed and accumulated in the section of the shipping department ready for automobiles to haul to destination.

Provision has been made for separate doors for both shipping and receiving, to eliminate the possibility of incoming goods being confused with outgoing shipments. Scales set flush with the floor are immediately in the entrance way, with a section set aside for the receiving department, so that all incom-



Switchboard. Packing Benches. Shipping Department.
Distributing Conduits. Metal Chutes. Conduit Racks

ing goods can be carried across the scales and weighed without unnecessary delay. The receiving department is likewise provided with assembling benches similar to the shipping, in which small incoming pickups are assembled, the number of the bin being conveyed to the original bin so that assembler can readily match pick-up orders with goods assembled from stock.

Rigid iron conduit, No. 14 rubber covered wire, locknuts, bushings, elbows and couplings and similar articles considered either fast moving or difficult of handling, are carried on the main floor. To facilitate this work, special conduit racks have been provided for the proper storage of this material. Storage provision has been provided in the main floor for a capacity of 12 carloads of conduit, and accordingly the first floor has been designed to carry approximately 2000 lbs. per square foot if necessary.

The electrical equipment, in addtion to that already described is most complete. Both direct and alternating current is supplied at 110 and 220 volts by the Pacific Gas & Electric Company and the City Electric Company. The incoming mains pass directly to a slate switchboard in the basement. This board is equipped with D-12 knife switches for every circuit in the building, time switch and battery charging rheostat for electric auto trucks. General Electric glass face instruments have also been provided for the battery charging circuit by means of a charging plug at the rear of the building. The batteries may be boosted during the noon hour or when the automobiles are loading or unloading. Special panels have also been provided in the store and fourth floor display room to provide current up to thirty amperes for various devices such as electric ranges, rectifiers, fans, stage apparatus, etc. All the store lights together with four outlets for exterior arc and cluster lamps, special outlet for electric signs and two outlets for street posts are controlled either by the main switch from the store, or may be thrown over to the time switch. All service throughout the building may be discontinued by a contact push-button switch in the main lobby which has been provided for the special use of the fire department. All the large motor control devices are on 220 volt d.c. thus giving good speed control and economy in wiring as well as permitting the adoption of regular standards.

The passenger elevator at the front entrance is of the Otis automatic type, operated by one 15 h.p. General Electric motor with a capcity of 2000 lbs. at 175 ft. per minute. In addition to the usual control apparatus, it is provided with a safety attachment which prevents the removal of the car from any floor before the passenger is ready to alight. During the day the passenger elevator is operated by an attendant, so that the automatic feature is used only at night and other odd times. The elevator doors are of wrought iron and polished plate wire glass with transoms above, thus lighting the shaft and making it fire-proof.

The freight elevator is of the Otis automatic type operated by a 15 h.p. General Electric motor tested to a capacity of 2750 lbs. at 75 ft. per minute. It is further provided with automatic gates which will not allow the elevator to be operated while a gate is open, thus avoiding danger of unprotected hatch-ways. It

is arranged for both automatic call and dispatching, being the first of its kind to be installed in a freight elevator.

The two automatic lifts are of the Otis type of 200 lb. capacity operated at 175 ft. per minute. They give service between the basement and fourth floor and are equipped with the call bells for each floor, electric lamp signals showing arrival of car at destination.

A Lamson automatic tube system is arranged with a central station and tubes from the various floors centering to one point, from which they are re-distributed to the various departments. This is used for distributing correspondence throughout the building and the dispatching of orders. The carriers are twelve inches long in order to receive the ordinary charge tickets, the largest paper in use, and as a result, special radius bends are necessary. Each carrier is provided with a double revolving disc whose number and letter indicate to the attendant at the central station its proper destination.

The excelsior room, steam heating plant and vault are reached from the basement and so situated under the sidewalk or in the lightwell so that they are distinct from the building. All these doors as well as those of the elevator and lifts are tin-clad with lock seams. Metal chutes are provided in the front and rear of the basement to facilitate delivery of the material stored there. The building is provided with six exits in case of fire, there being stairways, elevators and fire escapes at the front and rear.

All floors, beams, posts and other framework are of slow-burning construction. This type of construction is considered by insurance companies as a very safe risk. The timbers are of such dimensions as to make risk from fire very remote. The columns range in size from 14 in. to 16 in. in the basement to 10 in. by 10 in. in the fifth floor, while 8 in. by 8 in. columns, the smallest size permitted by the rules of the National Board of Fire Underwriters, support the roof over the sixth story.

The girders and beams throughout are respectively 12 in. by 20 in. and 10 in. by 16 in., except those supporting the roof, which are respectively 8 in. by 12 in. and 8 in. by 10 in. The girders supporting the first floor were reinforced by bolting together two pieces of timber, each 6 in. by 20 in., between which was placed a steel plate ½ in. thick and 20 in. deep running the full length of the girder.

The windows of Mission street frontage, where there was no insurance credit or penalty, are of wood, pivoted and arranged with transom. All others are fireproof metallic windows, glazed with wire glass. The windows of the fifth floor are double hung and the glass polished plate. Those in the lofts facing Minna street are fixed sash of wrought steel construction, having pivoted sections. The glass being corrugated. A steel and glass awning is to be put up at the rear of the building to protect teams while loading and unloading.

From this description it is seen that every provision has been made for the rapid and accurate handling of orders which foresight and ingenuity can devise. The building was erected under the immediate direction and inspection of the company, the architect being Leo J. Devlin.

THE DIESEL ENGINE FOR CENTRAL STATION SERVICE ON THE PACIFIC COAST.

BY J. W. WHITE JR.[1]

The communication to the Journal by the Snow Steam Pump Works through their consulting engineer, Mr. S. B. Daugherty, in discussion of the writer's article in your issue of November 2, 1912, is extremely interesting because it gives authentic data on the subject of Diesel engine operation from one of the largest manufacturers of power machinery. If the manufacturers in general would give as much data in proportion as that contributed by Mr. Daugherty, the Diesel engine would take its proper place among prime movers in a short time.

In discussing the development of the Diesel engine in his article of November 2d, the writer had in mind to present to the readers of the Journal information representing the general development, and not the specific development of the Diesel engine by any one manufacturer, and therefore, while a number of points taken up by Mr. Dougherty in criticism of the writer's article may be correct in so far as a comparison between the writer's article and the Snow engine is concerned, still the general development of the Diesel engine from a commercial point of view is in nowise changed by Mr. Daugherty's remarks.

Mr. Daugherty takes exception to a number of points brought out by the writer, particular among which are:

(a) The relative merits of American and foreign built engines, in which the writer stated that the European design is the more successful.

(b) A smaller increase in fuel consumption for the two cycle engine than that given by the writer.

(c) Application to central station service.

(d) Cost of Diesel engine plant.

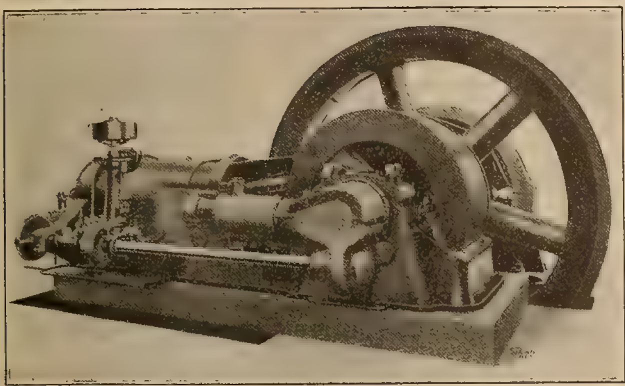
(e) Application to California conditions.

With reference to Mr. Daugherty's remarks regarding American and German practice, in which he asks, "What is American practice?" It would appear that if but one engine has been built and designed by Americans, and is distinctive in its features, it would be "American practice." As a matter of fact, the American Diesel Company and the Atlas Engine Company both make a Diesel type of engine of distinctly American design, and to which the writer referred as American practice. Whether the design of the Snow engine is superior to that of the engines referred to has not as yet been demonstrated to the American public, and whatever the result of such a comparison might show, the two companies mentioned must be credited with the fact that they have been the pioneers in the building of what constitutes the American design in Diesel engines, and inasmuch as they have spent considerable time and money to develop their product, Mr. Daugherty should give them credit for the pioneer work done.

Both of the above companies have a number of Diesel installations which are operating very economically and successfully, where installed under the proper conditions, and using the proper fuel. One of the principal reasons why the Diesel engine has not secured a strong foothold in America is because it

[1]Consulting Engineer, 722 Mills Bldg., San Francisco.

has not been applied under the proper conditions. Who shall say that a good boiler is not a good boiler when the chemical deposit in the feed water chokes up the tubes. It is the indiscriminate purchase and use of Diesel engines, together with the exaggerated claims for it by unprincipled salesmen which has held back its advancement.



Koerting Diesel Engine (German).

A great many of the features, which are mentioned in Mr. Daugherty's article, covering the design of the Snow engine, are similar to German practice, but in accepting and incorporating the features of German design into American engines does not constitute American practice. German features are apparent even without the use of the label "Made in Germany."

(b) As to the increase in fuel consumption of the two cycle engine over the four cycle, Mr. Daugherty admits that it is higher, and takes exception only to the concrete figure of 18 per cent. This figure was simply given as an average, and varies with the design of the engine and the relative merits of the scavenging features employed. The figure of 18 per cent is that given by the Machinenfabrik Augsburg Nuernburg, A. G., which company is referred to by Mr. Daugherty.

The writer takes decided objection to the statement made by Mr. Daugherty that the screening of the inlet ports of American built engines is done to deaden the noise of entering air. The velocity of air through the inlet ports is relatively high, and therefore, if not screened, will draw in foreign matter, which will seriously affect the operation of the engine.

(c) In the writer's article, he calls attention to the application of Diesel engines to central station service under California conditions, and any remarks made cannot be considered as detrimental or imperical in the application of the Diesel engine to industrial service.

The requirements of central station service are the most exacting, and at the same time, give the lowest load factor. Therefore, the fixed charges to be figured against the Diesel unit have a greater bearing upon its use in central stations than it would under average industrial service conditions. It is definitely certain that the commercial application of the Diesel engine to certain classes of industrial and central station service will bring about cheaper power costs than any other type of prime mover on the market today, but until the manufacturing cost of Diesel engines is reduced materially, its general application for central station service will be limited.

In the writer's article of November 2d, he assumed the cost of a Diesel engine plant installed at \$150 per kw., and that of steam turbine plant installed at \$80 per kw. Mr. Dougherty is of the opinion that a Diesel plant would cost considerably less. The writer tabulates below an average of the cost of such a plant as Mr. Daugherty suggested; i.e., five units of 200 kw. each:

Switchboard installed—5 panel	\$ 2,000
5-200 kw. generators, f.o.b. factory	7,500
5-Exciters, f.o.b. coast	1,500
5 foundations, 150 yds. each at \$7 per yd	5,250
Erection of five units, weight each approximately 50 ton at \$10 a ton	2,500
Freight on 250 tons at \$1.50 per cwt	7,500
Building, approximately 120 x 50 ft	15,000
Station wiring	1,500
Crane installed	1,000
Engineering, superintendents at 4 per cent on \$150 per kw.	6,000
Total	\$49,750

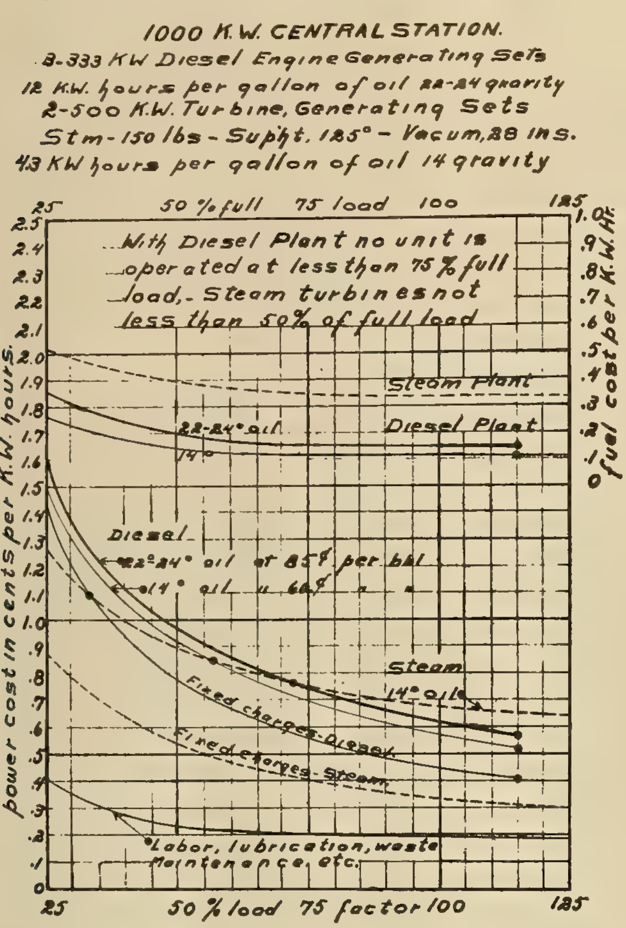
From the above estimate it is evident that if Mr. Daugherty's company can deliver engines for less than \$100 per kw. f.o.b. factory, every dollar less than this amount may be deducted from the writer's estimate of \$150 per kw. The readers of the Journal would appreciate advice from Mr. Daugherty as to the approximate cost per kw. of Diesel engines f.o.b. factory, because this more than any other factor will determine their applicability to central station service on the Pacific Coast.

On the basis of the above costs per kw., a curve is presented showing the total power cost of both Diesel and steam turbine units in this specific instance. Above 1000 kw. in capacity, the comparison will be much less favorable to the Diesel engine; while if a single unit were to be purchased of 200 kw. capacity, the Diesel engine would have a decided advantage over the steam unit, assuming Mr. Daugherty's statements are correct, and figuring 33 per cent thermal efficiency of the Diesel units.

Snow American Diesel Engine.

Figuring 30½ per cent thermal efficiency as an average operating condition to cover lower efficiency at fractional loads, and also for fall off in economy due to wear of piston rings, etc., the power cost curve of the Diesel engine being plotted for oils of 22 to 24 gravity, and also for oils of 14 gravity, (upon which the Snow engine is claimed to operate successfully), the power cost for fuel only will be noted on the upper half of the curve; while the total power cost is given below. In this comparison, labor, lubrication, waste, and maintenance charges are assumed

the same for both steam and Diesel units. The maintenance of the Diesel engine so far has proved to be much higher than the steam turbine, but this is offset to a great degree by the absence of boilers.



Due allowance has been made in the steam plant power cost for banking and standby losses, as mentioned by Mr. Daugherty.

Examination of this curve will show with 5-200 kw. units none of which are operating at less than 75 per cent full load, the full load power cost curve of the Diesel engine when operating on 22 to 24 gravity oil crosses the power cost curve of the steam turbine at 72½ per cent load factor. If 14 gravity oil is used, the power cost curve of the Diesel engine crosses that of the steam turbine at 57 per cent load factor, and if the cost of fuel is left out entirely as a charge in the total power cost of the Diesel engine, the curve showing the fixed charges of the Diesel engine crosses the total power cost curve of the steam turbine at 33 1/3 per cent load factor. Therefore, Mr. Daugherty's calculations showing that the power cost curve of the Diesel engine, including fuel, crosses that of the steam plant at 33 per cent is entirely erroneous.

It is admitted that the low price of fuel on the Pacific Coast shows the oil engine at a disadvantage, but while the price of oil is undoubtedly on the rise, the price of refined oil is going up faster than the price of crude, so that if the Diesel engine is not successful in operation on 14 gravity oil, the advance in price of the refined oil over the crude oil will partially offset the better showing of the Diesel engine over the steam turbine with increased fuel cost.

The conditions under which the writer compared two units are actual conditions at the present time. What the future holds will be subject matter for further comparison. Diesel engines are operating on the Pacific Coast successfully on 24 gravity oil, but we are not advised of any engines operating on 14 gravity oil. Mr. Daugherty omitted some very important information in his article in connection with the use of low grade oil, i.e.: what percentage of asphaltum they can successfully burn with fuel oil, and also the effect of the sulphur content in the oil, and the limiting percentage.

The engineers on the Pacific Coast are intensely interested in the success of the Diesel engine, but the installation of an oil engine on the Pacific Coast under improper and adverse conditions, and under claims which cannot be substantiated, are more harmful to a growing business for the manufacturers, and will be more detrimental to the interests of the power users than the under-rating of its merits.

The question of the oil gravity and carbon content which a Diesel engine can burn successfully is just as vital as the limiting percentage of hydrogen contained in gas for large gas engines,—————— the ill-advised installation of which has cost the central station man, the manufacturer, and the ultimate customer on the Pacific Coast a great financial loss, as well as holding up the application of the large gas engine to Pacific Coast conditions for four or five years.

The Snow Gas Engine Company is to be congratulated on bringing out a Diesel design which can operate at such high efficiency on such low gravity oils, and its installation on the Pacific Coast will be watched with great interest by everybody.

NEW TRAFFIC ORDINANCE AT PORTLAND.

The traffic ordinance recently passed by the Portland City Council went into effect on January 12th. It provides for the whistle system of traffic regulation by the police, a new departure in Portland. It defines a "congested district" in which a speed of 15 miles per hour is permitted, as compared to a previous limit of 12 miles per hour in the city limits. Outside of the congested district, but within the city limits, 25 miles per hour is allowed. This provision, as well as the one making it unlawful for a driver to knowingly delay a car when it can be avoided, are particularly favorable to the street railway company. Another clause makes it unlawful for any vehicle to stand in any one place in the congested district for more than thirty minutes, and no more than one such period within two hours between 9 a. m. and 6:30 p. m.

THE MYRIAWATT.

A myriawatt is the unit of thermal or mechanical power recommended by committees from the A. S. M. E. and A. I. E. E. to be used instead of the term "boiler horsepower" in connection with boilers, producers, turbines and engines. The myriawatt is 2 per cent larger than the most recently determined values of the boiler horsepower, also being 10 kilowatts. By this means the long existing incongruity of stating the input and output in different and disconnected units of power will be eliminated.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

MUNICIPAL ORDINANCES ON WIRING.[1]

BY H. JOSLYN.

In response to your kind request to present a paper on our municipal ordinances governing electric wiring, and particularly wiring in buildings, I have tried on several occasions to draw up a paper covering this subject. I find, however, that I might as well take the ordinances and read them to you as to do anything of that kind, because so many points are covered that even to begin writing about them in a general way would require a great deal of time. I prefer, with your indulgence to take up the main points on our inside wiring ordinance and discuss them in general without reference to manuscript. It will be more or less of an informal talk on the subject.

The wiring inspection work in Seattle, so far as a regular office is concerned, dates back some thirteen or fourteen years when the Underwriters' Electrical Inspection Bureau was established, under our insurance surveyor's office, with Mr. Hughes as head inspector. This office grew rapidly until it assumed considerable proportions and covered practically all of the wiring done of any importance, particularly that out of which they could get a fee. In the early years of my service with the city I found that the inspection rules were not the same in all cases, some contractors being required to do one thing on one job, and others differently on another, much to the discredit of the inspection office. Investigating municipal inspection in other cities, I found that its establishment had practically done away with controversies of this kind. Upon taking up the matter with our city council, we met with strenuous opposition from the insurance surveyor's office for several years, but were finally successful in obtaining passage of ordinances regulating the wiring in buildings. A few months after the establishment of our inspection office the insurance surveyor for the state notified us that they would gladly accept inspections made by the city department, and since that time our relations have been very pleasant. Mr. Cheney, who is electrical engineer under the insurance surveyor's office for the state, has endeavored to co-operate with our office at all times; and we understand that his principal work now is an endeavor to keep municipal inspection throughout the state up to the standard. We use his office and the underwriter's laboratory as a reference, particularly on approved material and equipment.

The National Code, as you doubtless know, treats fully of the insulation of wire and construction of electrical equipment, but it is impossible to use the code as a reference in a city ordinance. It would have no standing as a book of reference in case of contest before court. After consultation with our legal department we found that the ordinance would have to embody the rules of the code drawn in a manner to make them mandatory. To this end, practically all the code is embodied in our city ordinance, but the statements are positive, and the word "Approved" is used as little as possible.

The first important point in inspection work is to obtain knowledge of the work to be done, to which end all people doing electrical work are required to come to the office of the city electrician and take out a permit, based upon their written application. At the present time a schedule of fees is in use for permits on different classes of work, but the fee system will be abolished on and after January 1, 1913. A duplicate copy of the permit issued to the contractor is attached to his application and given its serial number, thereupon becoming the basis of the office records for that particular piece of work. The card catalogue of addresses for the different jobs is also kept as reference only. All copies of corrections found by the inspector on each job are attached to the respective permits with a view to making the permanent record of the wiring in each house; all of which is accessible when any person desires to look up the wiring conditions regarding property they wish to purchase. The regulation of the ordinance applies particularly to wiring for light, power and heating devices, there being no particular requirements on call bell or small signal wiring, unless the wires are close to those carrying higher voltages; in which case the rules of the ordinance must be observed the same as for light and power wiring.

The city ordinances prescribe that in buildings of the "A," "B," "C" and "D" Classes, according to classification of the city building ordinances, and in buildings used for storage and warehouse purposes, all wiring must be encased in metal conduit, armor or molding. Practically speaking only frame buildings are exempt from the four classes mentioned above. It is also required that wiring for building of the above classification shall be shown upon a diagram or plan filed with the application for permit. Cabinet boxes in all buildings must be of metal.

After permit is issued to the contractor, the office depends upon him to notify it by permit number when the work is ready for inspection. There is a mistaken idea among some people that the inspection department has only 48 hours' time to make inspection after having been notified that the work is ready. This idea is not in any sense correct, and the ordinance prescribes a penalty for any person covering up work before inspection; in addition to which the inspector is authorized to remove lath, plaster, etc., to obtain proper view of the wiring.

It is further prescribed that after three months, or oftener, if desired, the inspector may go into any building and re-survey work that has been done. If any wiring is found to be in a hazardous condition a report is made to the chief of the fire department upon the basis of which he is authorized to condemn the wiring.

The electrical rules may be sub-divided into two principal parts, viz: Construction and Installation.

[1]Address by the City Electrician of Seattle before the Seattle Branch of the American Institute of Electrical Engineers.

Under the head of construction the principal change in recent years in the regulations of the National Code has been in the insulation of wires. Rubber insulation is now subjected to four tests, viz: 1st—The voltage test applied after the completed wire has been immersed for not less than 12 hours. 2d—The elasticity test, which consists of revolving insulated wire around a shaft under pressure and the whole immersed in water for 24 hours, after which it must resist insulation break down test of 1500 volts alternating current. 3d—The stretching test which is given to a sample of the insulation carefully cut from the wire. 4th—A chemical test which is practically only used by the testing laboratory. The stretching test is applied by the inspector in the field to determine the character of the insulation and consists of stretching a sample, upon which marks have been placed 2 in. apart, slowly until the marks are 5 in. apart, then it must recede to not more than 2½ in., after which the wire must again be stretched until the marks are 6 in. apart. The insulation of all wire is treated as new, whether it has been in stock 10 days or 6 months, and must withstand the above test in the field. Lead covered wires have practically the same tests, except that they have lead covering. The braid upon rubber covered wires must meet the approval of the inspector, which means that a braid must not be rotten or insufficiently saturated with a preservative compound.

Flexible cord is generally divided into three grades: 1st—The so-called "Common Cord" which is usually stranded wire covered with rubber and an outside casing of ordinary cotton wind. This cord is not approved for use as line wire or for general purposes other than suspending a light in a vertical direction not lower than 6 ft. from the floor. Common cord is not permitted in show windows or in places of unusual temperature or moist air. 2d—Reinforced cord is practically the same as common cord, but with an additional strong outer covering of a substantial character. With this protection it may be used for ordinary portables and some in contact with furniture or other surrounding objects not possessing sharp edges. For use in damp places the outer covering must be saturated with a moisture proof preservative compound. 3d—Cords for heating appliances are required to have covering of rubber not less than 1/64 in. thick and a braided cover of not less than 1/32 in. thick, which shall be composed of long fibre asbestos; and the several conductors comprising the flexible cords must be enclosed in an outer reinforcing covering of approved strength.

Fixture wire is the one exception to the rule that No. 14 wire is applied to all branch circuits. On account of reduced load and smallness of space to be occupied, fixture wire may be used in sizes as small as No. 18 gage. The insulation shall not be less than 1/64 in. rubber for No. 16 wire, and must be covered with a standard braid.

Wiring for stage cables must not have less than 3/64 in. thickness on conductors of capacity not less than No. 14 wire; and the several conductors comprising the cable must be bunched together and covered with a strong outer covering; spaces between conductors having a filler to make the cable round and symmetrical. The city ordinances permit the use of wooden moulding in certain places when not concealed and it is vigorously required that all moulding shall be covered with shellac, both inside and out, as some protection against moisture.

Wires for use in conduit must have double braid to protect against abrasion and the general requirements for conduit, metal moulding and flexible armor are set forth in the ordinances along the lines of smooth interior surfaces and approved fittings designed to protect against sharp edges and allow reasonable space for splices. The construction of snap and knife switches, sockets, rosettes and fuses is all particularly specified in the city ordinances and material of this character must have the approval of the underwriter's laboratories. The inspection department has recently experienced some trouble with the construction of split knobs in that the bases of some knobs were found to be less than the 1 1-8 in. diameter required by the city ordinances. This matter has been taken up with the manufacturers and knobs of the required size are now being furnished. Metal cutout cabinets now being required, much trouble has been saved which formerly arose from insufficient lining and other details pertaining to wooden cabinets. It has not been the practice of the inspection department to favor cutout cabinets built up in sections, and some cabinets have been rejected because of the poor quality of fastening used for the door. All metal cabinets of large size should not only be constructed of metal, sufficiently heavy, but should have doors reinforced and mounted in a manner to effectually close the box at all times.

Under the head of installation the finest question arising is the location of main switch and cutout, which our ordinance requires to be at the nearest accessible point to the entrance of wires of the building. The average contractor does not seem to appreciate any danger in carrying his service wires for some distance into a building without a fuse as long as the wire is in conduit. In the past year or two several fires have been caused by this class of work and inspection departments generally recognize the importance of this regulation. In estimating the size of main and sub-feeds it is the practice of this office to calculate 6 amps. as the load for all branch circuits in stores, and similar installations. For hotels, office buildings and apartments the feeders may be estimated at 75 per cent of the total amperage obtained by multiplying the number of branch circuits by 6 amps.

In the installation of knob and tube work, particular attention should be paid to the proper installation of bushings; no knobs should be placed on header boards or the under side of floors; all taps should be relieved of strain upon the joint; wires should be at least 1 in. from the surface wired over and supported at distances not greater than every 4½ ft.; all joints should be thoroughly soldered and taped with both friction and rubber covering; all wires running in proximity of metal pipes should be protected therefrom by porcelain bushings taped in place; suitable mud guards in form of tubes should be placed on wires

above all floor plates and fire stops where run in vertical partitions; all wires run in side walls should be tightly held in position by knobs; and where wires are fished for any considerable distance they should be protected by loom. One frequent correction found by the inspectors is on the use of circular loom at outlets on porches and in other places where it may be subjected to moisture. In bringing wires into metal cabinets they must be protected by an approved porcelain bushing and no knock-out holes must be left open in cabinet boxes. The inspection department requires the use of loom at least 6 in. long for wires at all outlets, the installation of meter loops with wires extending at least 24 in. from cabinet box or point of leaving partitions; and service mains with at least 12 in. length for each wire measured outward from the service head.

In conduit work it is the general practice to limit the installation in ½ in. conduit to one circuit, and in ¾ in. conduit to two circuits. A few exceptional cases may arise in very short runs without bends where two circuits may be permitted to be pulled into ½ in. conduit. The use of oil or grease to facilitate the drawing of wires into conduit is strictly prohibited; powdered soapstone, or similar material being preferred. All conduit must terminate in an approved outlet or junction box, or condulet, and it is necessary to install locknuts and bushings in all cases to insure tight connection between conduit and outlet or junction boxes. One correction often found in connection with conduit work is the neglect on the part of the contractor to see that outlet boxes are properly fitted with covers; and it has, at times, been very annoying to the department to hold up certificates of inspection for one or two small details of this character.

Approved ground clamps are required for connection between ground wires and conduit; and it is the general requirement that conduit shall be grounded with the possible exception of a piece one or two feet long used for encasing service wires in a residence where the rest of the wiring is not in metal.

Flexible metal conduit, both as an open tube and as an armor for prepared cables, has largely increased in use since the establishment of the inspection office on account of its convenience in wiring in awkward places about buildings. Its use is approved in all cases except where surrounded by permanent dampness or moisture.

Fixtures are required to be insulated from gas piping by an approved insulated joint, and canopies must be thoroughly insulated where placed against plaster walls or ceilings in fireproof buildings, or against walls and ceilings made of metal or containing metal lathing. All fixture arms smaller than ½ in. outside diameter must be firmly secured by cement or the use of a set screw; and flat canopies on electric or combination fixtures can only be used in connection with outlet boxes. Fixtures must not be used in show windows or in the vicinity of inflammable material when wired on the outside; and when installed on the outside of frame buildings must be of waterproof construction.

Special equipment in form of vapor tight globes is required for enclosing sockets used in rooms containing inflammable gases, acids or other injurious fumes; and it is a general requirement of the department that sockets and similar current carrying equipment must not be installed where the person handling the same is liable to grounded contact. This latter provision applies particularly to sockets in lavatories, bathrooms, etc.; and it is a general requirement that in small bathrooms switches shall be placed on the outside of the wall. Pull chain sockets with an insulating link in the chain are approved for use in places of this character.

Corrections are frequently made upon the insulation of flexible cord on account of its not having a knot for taking off strain from its connections in sockets, rosettes, etc., and because the stranded ends of the wire are some times left in loose form instead of being taped into the form of an eye or dipped in solder to make solid.

Some criticism of the office has been made by contractors because their statement of load to be placed upon branch circuits, etc., will not be accepted by the department without investigation of conditions. It has been found necessary for the inspectors to check up the probable load to be placed upon circuits, both from plans and on the ground, in order to determine a reasonably safe size for the feeders. In general the office will not approve of more than eight outlets on branch circuits in residences and six outlets on branch circuits in business buildings. Considerable question has been raised as to the size of wires to be installed for alternating current motors of different capacities; and the tables furnished in the back of our printed copy of the ordinances are intended to serve as a guide for this purpose. Tables are also printed giving other useful data and diagrams are shown illustrating the method of wiring for the heating and cooking service furnished under special rates by the city plant.

A particular portion of the ordinance covers the wiring of theatres with a number of regulations peculiar to the type of equipment used; and on account of its special application the subject will not be dealt with at present.

Since the establishment of the inspection department in July of 1910 almost 24,000 permits have been issued and approximately 45,000 inspections made. It has been difficult to find time for resurvey of work done at previous periods, but it is our hope to begin doing this at an early date. The improvement in the class of work done in the city since the beginning of municipal inspection has been very noticeable; and we do not know of any instance where a fire has been caused from an electrical hazard in an installation which has been inspected by the office. On account of the varying personnel of contractors and wiremen who take out permits, the office does not seem to be able to get away from answering questions of the simplest character in regard to work being done; and we urgently recommend that steps should be taken to obtain the passage of a state law which shall determine by examination the qualifications of any or all persons desiring to install electric equipment and govern their practice by proper licenses. I thank you for your courteous attention.

OUTSIDE WIRING.

BY J. J. WETTRICK.[1]

The subject of outside wiring is confined mainly to wiring upon poles and upon building roofs and the outside of building walls.

At the general election of March, 1911, there were passed two ordinances, one an Initiative Ordinance and the other a Referendum Ordinance.

In this way there were two ordinances submitted pertaining to overhead wiring at the general election of March, 1911, which were in some particulars contradictory but both of which passed.

There is a charter provision which provides that in a case like that the one receiving the most votes shall be the one in effect. That happened to be the initiative ordinance so that the referendum ordinance became void. They were the same in the main. The initiative ordinance was gotten up by the Linemen's Union of the city and the referendum ordinance by the public utilities department in conjunction with the city lighting department, telephone companies and Puget Sound Traction, Light & Power Company. The initiative ordinance, in fact both ordinances were designed to protect the linemen and firemen in their work by removing as many as possible of the dangers attending their work and making it possible for their work to be more expeditiously done.

The difference in the two ordinances is that the initiative ordinance is more strict, generally speaking, than the referendum ordinance; that is it requires things that were deemed unnecessary and that were consequently not included in the referendum ordinance. I have a copy of both ordinances and I will take the initiative ordinance and run through it hurriedly, taking up the main points of interest and comparing them as I go along, with the referendum ordinance. They are somewhat similar all the way through with the exceptions stated.

Section 1 merely gives some definitions.

Section 2, Division 1, states that it shall be unlawful for any wire carrying 600 volts or less to be placed within 13 in. of the center of a pole. There is somewhat of an absurdity creeps in here from the fact that the provision applies to wires of 600 volts or less only, which would mean, if the ordinance were strictly construed that any wire over 600 volts could be placed within less than 13 in. of the center of the pole, which is the very fact which they aimed to avoid; it is the high tension wires that we wish to keep away from the pole. There are some exceptions to this provision. The first one is: Wires that come from underground conduits and pass up vertically on the pole and then along the lead. Bridle or jumper wires attached to signal wires on the same pole. Aerial cables terminating upon a pole. That I think refers mainly to telephone cables. A fourth exception is a wire or cable attached to the top of a pole. This affects the city electrician more than any other as he generally runs his wires along on tops of the poles.

In addition to these four exceptions which are all that are mentioned in the initiative ordinance, the referendum ordinance has two other exceptions. The first, telephone or telegraph cables on purely telephone or telegraph poles. The telephone company has a method, where they run short of wires, to fasten rings to the bottom of cross-arms and run some duplex wires through, sometimes one-half a dozen or more, so this is an instance where the referendum ordinance was a little more liberal by excepting these from the provision of 13 in. from the center of the pole. There should be a space of 26 in. between the two wires nearest the pole for the lineman to crawl through.

Section 2, Division 2, says that wires of 600 volts or less shall not be run along a pole without being attached to it within less than 13 in., practically the same as the foregoing.

Wires of less than 600 volts must be not less than 3 ft. from wires of over 600 volts. This may seem peculiar from the fact it makes the dividing line 600 v. so that you could take any wire above 600 v. say 2200 v., and place it as close as you wished to a 5000 v. wire; or you could take a 2200 v. and put it next to a 60,000 v. but the reason that was done was the way it affects the the lineman's work.

There are some exceptions to this rule as specified in the ordinance. The first one is that of secondary wires, where they enter the transformer. For a distance of 3 ft. measured along the wire this rule does not apply.

Another exception is: wires within buildings and structures. This should more properly be in the inside wire ordinance; and another exception is underground wires placed vertically on poles and service wires leaving poles to go to buildings. This is about the same as it is in the referendum ordinance and necessitates what might be called freak construction, principally in connection with the street lighting system. The street lighting circuit, which carries from 2400 to 5000 volts, is usually placed on the outside of the upper cross-arm and, in order to reach the light which is usually on a gooseneck farther down the pole, and at the same time keep three feet away from all wires under 600 volts, it is necessary to put a bracket extension on the arm carrying the street circuit, going from here back to the pole just above the gooseneck, then out to the light. The most difficult situation is the one when the light is on a corner pole with wires going in four or more directions. This has been met with what might be called mast arm construction, consisting of a mast or iron pipe from 10 ft. to 15 ft. long placed on the pole in a horizontal position or at right angles to the pole. The wire is then run down over the end of this, then back to the pole and out to the light as before. The most important effect of this provision, however, is that it required the reconstruction of practically all the light and power leads in the city, which means an expenditure of approximately $250,000 on the part of the city lighting department and $150,000 by the Puget Sound Traction, Light & Power Company due to the fact that all the leads built before this ordinance went into effect were built with the then standard distance of 2 ft. 4½ in. between centers of cross-arms and this must now be 3 ft., and 4½ ft. where buck arms are used. The majority of the poles are not of sufficient height to permit this change and must be replaced with longer poles, particularly in the case of combination leads.

[1]Chief Engineer, public utilities department, Seattle.

Section 2, Division 4. Relates to guy wires. All guy wires must have an insulator not less than 8 ft. nor more than 10 ft. from each end; that means two insulators on all guy wires. This seems to be superfluous, especially in guys on poles carrying only low potential wires such as telephone and signal wires. I might say at this point that we have found that it is not a good policy to insist too strictly on all of the provisions of this ordinance. The Supreme Court of the United States has indicated a way out of difficulties of this kind and we have followed them somewhat by reading into the ordinance the word "reasonable" and find that this avoids a great deal of trouble. The only exception to this provision of an insulator or circuit breaker at each end is in the case of guys to anchor rods which must have at least one insulator.

The referendum ordinance has one further exception and that is grounded cables when they are not above electric light wires. It doesn't say exactly what is meant by grounded cables but I presume it means messenger wires that support the telephone lead covered cables. They are grounded at intervals along the route and when they terminate on a pole it is necessary to guy the pole, due to the strain and the referendum ordinance did not require a circuit breaker in this guy. This is a very good exception for the reason that there is so much strain in these guys that it is difficult to get a circuit breaker that will carry the strain.

Section 2, Division 5, simply says that vertical wires on poles must be encased in wood not less than 1½ in. thick. The referendum ordinance in this particular says that they should be sufficiently encased providing metallic cases should not extend upward to a point higher than 4 ft. below the lowest cross-arms. In the initiative ordinance no metallic casing is allowed.

Section 2, Division 6, provided that no transformers are to be placed on poles carrying arc lights. This, I think is a very good provision that did not appear in the referendum ordinance.

Section 3. Telephone, telegraph and messenger wires are to be placed on separate poles from light and power wires when possible but when on poles carrying electric light and power wires suitable guards shall be maintained between them. The referendum ordinance is more strict. Such wires must be 4 ft. from any wire carrying 300 v. or more, and also provides for guards approved by the superintendent of public utilities. It is not the best practice to put telephone or telegraph wires on poles carrying electric light or power wires but is sometimes necessary due to the fact that both sides of the street may be occupied by electric light and power wires and the telephone company must get on that street. Heretofore the practice has been to put these wherever space was available but we have tried as much as possible to keep the telephone or telegraph wires below the electric light and power wires for the reason that the latter stand more strain or are less apt to break, leaving less danger of contact between the two.

Section 4 relates principally to transformers and is the same as that in the initiative ordinance, except that the first three divisions of this section in the initiative ordinance did not appear in the referendum ordinance. The first division of section 4 reads as follows:

Where transformers are to be connected to high voltage wires the secondary system must be permanently grounded and provision must be made for it when transformers are built. The referendum ordinance has the provision making it obligatory to have transformers grounded. This simply says they may be grounded.

Division 2: They shall not be attached to outside of buildings unless separated therefrom by substantial supports and shall be placed where practical on poles rather than on buildings.

Division 3. All transformers used for low potential distribution in the city of Seattle shall conform in insulation material, method of insulating, construction, reconstruction and repair to the latest standard practice, and shall be subject to break-down tests between the primary and secondary coils and cases at three times the highest normal voltage alternating. Said test to be made by the owner, constructor or repairer of said transformers, as the case may be, who shall provide himself or themselves with step-up transformers or other means of procuring the required test electromotive force, and said tests shall be made in the presence of and under the direction of the superintendent of public utilities when so required.

The referendum ordinance has a further provision that the manufacturers' certificate of inspection shall be accepted as complying with the ordinance so that a purchaser of transformers, if he has a manufacturer's certificate of test, need not go to the trouble of applying for a test.

Section 5 provides that all wires originating or terminating on an insulator attached to a pine, shall be attached to at least two such insulators except wires to buildings or wires originating or terminating on strain insulators or circuit breakers.

In this particular the referendum ordinance excepted wires of 14 B. & S. gauge or less, which includes telephone, telegraph and signal wires. To strictly comply with this ordinance it would mean that wherever a telephone wire terminates on a pole it must be attached to two insulators or two pins which means a pole would have to be double cross-armed. There is hardly any pole that does not have at sometime a wire terminating on it so it means that after a few years practically every telephone pole would be double cross-armed. This is one place where we have read into the ordinance the word "reasonable." We always require a double cross-arm where the lead terminates where there are only one or two wires terminating on a pole not at the end of a lead, we do not require it to be double cross-armed because it seems unreasonable.

Section 6 refers to roof fixtures and does not appear in the referendum ordinance. The main provision in it is that all roof fixtures shall be of a type approved by the superintendent of public utilities and must be painted. It also says these fixtures shall be of such height and so placed that all wires supported by them must be seven feet above the highest point of roofs of less than ¼ pitch and not less than one ft. above the ridge of roofs of more than ¼ pitch. A question comes up here in connection with fire walls, say a fire wall extends 4 ft. above the roof of the building and while we may have a roof fixture that keeps the wire 7 ft. above the roof would not keep it 7 ft. above this fire wall, so it was up to us to say whether this ordinance was intended to require the wires to be 7 ft. above the fire walls. Of course one of the purposes of the ordinance was to protect the fireman in his work and it would be a good thing to have all wires 7 ft. above these fire walls, but it is not practicable because it would require such tall and expensive roof fixtures. So we have been rather inclined to construe the ordinance as not requiring wires to be placed 7 ft. above fire walls.

Section 7 relates to poles. About the main provision in this is that it requires all poles to be painted, which is one of the things that we have not been able to enforce. The referendum ordinance only requires poles on graded streets to be painted. That is one of the things that gives us a great deal of trouble in trying to get poles painted. The companies and the city lighting department as well, do not seem to consider that it is worth spending money for.

Division 6, Section 7 is rather a peculiar one and is somewhat obsolete since it provides that no pole shall be set within less than 10 ft. of any gas lamp. There are no gas lamps in this city. The referendum ordinance provided that no pole shall be set within 10 ft. or less of a cluster light pole. That would be more up to date. It also requires that all poles shall be at least 5 ft. from any fire hydrant. Section 8 requires that all pins carrying wires of 600 volts or more shall be painted bright red.

Section 9 relates to grounding of transformer secondaries and is practically the same in both ordinances.

Section 10 gives the superintendent of public utilities power to condemn defective wires. Any wire which is considered dangerous to life or property must be condemned; it is made obligatory on his part to cut the wire from the source of electric energy when found to be dangerous and not repaired after 48 hours notice. The way it reads there is some question as to whether this would include telephone wires since it says that any and all wires or other apparatus used for electric purposes.

(To be continued.)

OREGON'S WATER RESOURCES, THEIR DEVELOPMENT AND USE.[1]

BY JOHN H. LEWIS.[2]

The streams of Oregon, if harnessed and put to work will furnish more than three million horsepower, and irrigate about three million acres of land according to the best available information. The total power from all sources used in Oregon today is probably less than 300,000 horsepower and the irrigated acreage as given by the U. S. Census is only 686,000 acres.

With these enormous possibilities for development it is no wonder that Oregon has taken the lead among all the states of the union in the enactment of beneficial water laws. Without positive laws protecting capital already invested or to be invested in works for the utilization of water, no substantial progress can be made. Colonists seeking irrigated land will avoid, as a plague, those states where the cost of litigation over water has in some cases exceeded the original cost of the works.

The experience gained thus far in this campaign for the development of our water resources indicates that, while far in the lead, we have yet far to go to reach the desired end. Most of the small and relatively cheap irrigation and power projects have been constructed. Only the large and complicated ones remain. The Carey Act and U. S. Reclamation Act are of little assistance to us primarily because little public land remains in any of these projects and further for lack of funds or lack of security upon which to raise funds. Because of the enormous cost in thoroughly investigating these projects, and the uncertainties and delay in organizing for construction, we find neither public or private capital interested in getting detailed information. Without this information the public is groping blindly in the dark as to the proper policies to pursue. Some of our state and national laws dealing with the water power question are believed to retard rather than stimulate development, and injure rather than benefit posterity.

Before outlining a plan whereby it is believed that this information can be secured without ultimate cost to the public, a brief report of progress will be made after which one large irrigation project also one large power project will be described so as to indicate the value to the public in adopting such plan.

Progress in Legislation.

The old method of government by injunction in water matters was put an end to by the enactment of a comprehensive water code in February, 1909. This limited franchises to the use of water for power purposes to forty years. It declares all water to be property of the public and creates a board consisting of the state engineer, and the superintendents of each of the two divisions into which the state is divided, to have charge of this property. Each of these officers has special duties to perform in addition to his board duties.

It is the duty of this board: (1) To determine and record all water rights initiated under early laws; (2) To grant rights to unappropriated waters for new uses; and (3) To protect all recorded rights by regulating diversions.

The U. S. District Court for Oregon after careful inquiry in the Silvies River case (199 Fed. p. 495) said:

> "The Act of 1909 is in effect a proceeding on behalf of the state through an administrative or executive board to have judicially settled in an economical and pracical way the rights of various claimants to the use of the waters of a stream or source of supply and thus avoid the uncertainty as to water titles, and the long vexatious controversies concerning the same, which have heretofore greatly retarded the material development of the state."

One thousand and sixty-eight rights to water have thus far been defined and recorded under this law, affecting 116,686 acres of irrigated land on 15 different stream systems without a single appeal to he supreme court.

In the granting of permits, any proposed use which will menace the safety or the welfare of the public can be denied.

Out of 2680 applications, up to December 1, 1912, 1746 were approved, becoming permits. The estimated cost of works to be constructed under such permits amounted to $41,868,819 and the applicants paid the state $47,592 or $7,592 in excess of the appropriation for the expenses of the state engineer's office for four years.

The distribution of water for the protection of water rights appears to be giving general satisfaction. Except for a small deficiency in the appropriation for adjudication work, the legal end of the water right situation appears to be well taken care of.

Stream Surveys.

The important legal question as to how to secure protection for capital to be invested, has thus been answered. The next question which must be answered as definitely is, how much unappropriated water is there in the stream under consideration? The state is systematically making stream surveys in order to answer this question. It is equal to the difference between the total water supply and the extent of vested rights.

During 1912, a little over $56,000 was available for stream gaging work, the making of topographic maps and water power surveys in Oregon. The work is carried on in co-operation with the U. S. Geological Survey, each party contributing one-half the expense. This amount was allotted as follows:

Topographic maps	$30,000.00
Stream measurements	17,300.00
Deschutes water power survey	6,000.00
Chemical survey	2,700.00
Total	$56,000.00

During the past biennial period ending December 1, 1912, a total of $34,121 was expended on stream surveys in Oregon. Discharge records were obtained at 194 regular stations. Some of these records, however, extend through only a part of the year, depending upon the purpose for which the information is to be used.

The work is well distributed throughout the state and is designed to furnish the information needed for

[1]Presented January 16, 1913, before the Oregon Society of Engineers, Portland, Oregon. Published by the author's permission.

[2]State Engineer.

irrigation, water power and other investments so far as funds will permit.

On the Malheur, Owyhee and Umatilla Rivers we now have reliable records of stream flow extending over a peiod of nine years and for such streams as the Deschutes and a few others only seven years, while for the Columbia River, at The Dalles, we have a thirty-three year record. The available information at other points is as yet entirely too meagre to warrant the investment of large amounts of capital in works dsigned to fully utilize the available water supply.

Chemical Surveys.

The quality of water is of equal importance to quantity. Some waters upon being analyzed are found unfit for irrigation, domestic or certain manufacturing purposes. Daily samples have been collected at twenty-four points on twenty-one streams during the past year and analyzed in groups of ten. These results are of permanent value as the quality of water at different stages is approximately the same for no material change from year to year is possible in the geological formation of the watershed.

Topographic Maps.

In planning irrigation, power and other projects the relative position of the land with reference to the available water supply is of importance. Topographic maps are therefore a necessity in promoting development. They are of permanent value and can be used for many purposes.

The total area of the state is 96,699 square miles and up to date there has been mapped 20,581 square miles or about 21 per cent. Should work progress at the same rate as for the past two years, it is estimated that it will take about thirty-eight years to complete the map of the state, and about four years to complete the Willamette Valley.

Practical working maps are being prepared for the Willamette Valley. They are published on a scale of approximately one-half to the inch and show contours of five foot interval up to 450 ft. with ten foot contours above this elevation. This work is being pushed northward from Eugene and south from Portland. In the rolling country, in the vicinity of Portland, these maps will be published on a scale of one inch to the mile, and show 10 foot contours.

That portion of the Arlington quadrangle east of the John Day River was completed this fall, thus making available topographic maps for the entire John Day Umatilla Project, on a scale of two miles to the inch and showing 25 foot contours. These maps are sufficient for general studies and are intended only as a guide for the location of feasible projects and to aid in planning detailed investigations, the cost of which should in some way be assessed against the community benefited. This is one of the projects which should be investigated by the public.

The cost of topographic maps varies in each case with the character of country, weather conditions, etc., but for maps on a scale of two miles, one mile, and one-half mile to the inch respectively, for work in Oregon is approximately $10, $30 and $50 per square mile.

System Incomplete.

Thus far we have a well balanced system relating to water and water rights, and one which under ordinary conditions should suffice. But only the more expensive projects remain and private capital engaged in irrigation work has learned from bitter experience that the larger the project the less likelihood of making a profit. In the power field we find many new industries, which could utilize large quantities of cheap power, but which industries cannot pay large or even reasonable profits to private capital for furnishing the power. For these reasons, the promoter whom we have heretofore relied upon to supplement the general information collected by the state, with detailed surveys and to work up a comprehensive plan of development, is conspicuously absent. No man will expend $50,000 to $100,000 in preparing reliable plans for a project unless he can see sufficient immediate profit to enable him to enlist private capital in construction.

Private capital is thus denied an opportunity of even considering practicability of constructing large projects in Oregon and the public, without definite information, is unable to adopt any new policy for construction with public funds. We have tried to promote development by increasing the profit to the promoter until we have reached a point where the cost to the water user is so great as to make it impossible for him to live under the burden. It is a detriment to the state to assist in any development work where the settler is doomed at the outset to fail.

State Promoter.

It therefore appears that the next logical step to be taken in this campaign for the development of our water resources is for the state to undertake the promotion of specific projects, at least for those large irrigation and power projects which are beyond the reach of private capital.

The cost of such detailed surveys, plans, specifications and estimates of cost, can be made practically a lien upon the project or lands to be benefited by withdrawing the water necessary for carrying out the project until such time as the state is reimbursed.

With such detailed plans and estimates available to the public, private capital in all parts of the world will have an opportunity to figure upon the project, and the water rights could be assigned to the one offering to construct the project upon the most favorable terms. With the promoters profit eliminated it may be possible to interest private capital more easily in these enterprises.

If private capital cannot be interested, then we will have full information as a basis for adopting some new plan. If the project is constructed by public funds which can be attached as a lien, then the first payment should be to a revolving fund equal to the cost of the surveys, and such money used for the investigation of a new project.

Co-operation.

These investigations could be carried out by the state alone, or by the state in co-operation with the

U. S. Reclamation Service. Aside from the saving in cost, there are many advantages in co-operation. The past experience of the state in co-operation with the U. S. Geological Survey, and other government bureaus should commend this plan. Already the Secretary of the Interior has expressed a willingness to recommend that $50,000 be set aside for the investigation of the Deschutes Project, if the state will contribute an equal amount.

In order to give some idea as to the development which may result from the successful carrying out of this plan, one large irrigation, and one large power project will be described somewhat in detail.

Deschutes Valley.

In the Deschutes Valley approximately 65,000 acres is now irrigated where there is a possibility of irrigating over 500,000 acres. If, however, the railroad is allowed to be extended through the only logical reservoir site in the upper basin, this possibility will be greatly reduced. If power plants are allowed to secure vested rights immediately below such reservoir site, it would seriously complicate, if not largely defeat such development. Water right withdrawals, and a comprehensive plan of development even without such detailed investigations would be a valuable aid in promoting the highest use of our streams as the public would then be in a position to protect the public interest.

The John Day, Malheur, Silvies River and many other projects should be scientifically studied and promoted by the public. Each of these as well as many others are too large and complicated for private capital to attempt to organize, and therefore to thoroughly investigate. Definite detailed information should be had for at least one irrigation project before it will be possible for the public to adopt any new policy relating to irrigation.

Power.

It is believed that the most rapid, and perhaps the greatest development will come through the putting to use of our undeveloped water powers.

Within the past few years, many new industries have been developed wherein cheap water power is the controlling factor. Some of these new uses are as follows: The making of iron and steel in the electric furnace; the manufacture of fertilizer from the air; in wood distillation plants with charcoal as a by-product; the manufacture of calcium carbide, aluminum, carborundum, graphite, and other products. Many electro-chemical industries have also been developed in recent years requiring large quantities of cheap power.

Cost of Power.

Where it cost $30 to $45 per horsepower year to produce power in large blocks from steam, using sawdust as fuel, much power can be developed by water in Oregon at from $7 to $12 per h.p. year in the vicinity of the plant. To transmit this power any distance will add to this cost. Toronto, ninety miles from Niagara Falls, is now securing 10,000 h.p. at $16.50 from a public commission, which pays $9 for high tension power at Niagara Falls. In other words, it costs $7.50 per h.p. year to transmit 10,000 h.p. ninety miles. To distribute this from the substation in the city will add still further to the cost.

The public is entitled to have detailed and reliable information concerning these matters so vital to the development of our state. Heretofore, we have dealt with this subject in generalities.

It appears high time that we get down to something tangible and thoroughly study at least one irrigation and one large water power project.

Having such information we can then probably agree upon some comprehensive water power or irrigation policy which will be for the greatest good to the greatest number.

Columbia River Power.

What is believed to be the largest, and perhaps, the cheapest water project in the world is located in the Columbia River near The Dalles, Oregon. Competing transcontinental railroads are located on either side of the proposed project and navigable water is available from the foot of the power house to the Pacific Ocean, and for many miles inland.

The present channel of the Columbia River will be completely closed by the construction of a dam approximately 170 feet in height at the head of Five Mile Rapids and a new channel excavated in solid rock around the dam and controlled by a removable dam 70 ft. in height and 1400 ft. long. A canal on the Washington shore, 300 ft. wide and 1½ miles long, will convey water to the power house at Big Eddy where 300,000 electrical horsepower can be developed at a cost of $23,076,000 or $77 per h.p., with 236,000 h.p. additional, incidental to this development and available eight months of the year. The annual cost for furnishing low tension power at this plant is $6.80 per e.h.p. year, charging all expenses to the 300,000 h.p. of perennial power. As much as one million additional h.p. can be developed at this plant at a cost of $44 and furnished at cost for about $4.50 per h.p. year.

Assuming that high tension power can be furnished at the plant for $9, a 27,000 h.p. block can be delivered in Portland for $14.40 per h.p. year, or approximately the wholesale rate at Niagara Falls.

It is believed that 240,000 h.p. from this plant can be disposed of at $9 per year, for the making of fertilizer from the air. This sale alone will fully meet all operating and overhead charges for the construction of the entire plant, leaving net profit to the state, any revenue obtained from the remaining 60,000 h.p. and 236,000 h.p. of part time power.

It has been recommended that the legislature appropriate $50,000 for the investigation of the Deschutes Irrigation Project, in co-operation with the Secretary of the Interior who has expressed a willingness to recommend the expenditure of an equal amount by the U. S. Reclamation Service; also that Oregon, Washington and the United States co-operate in the preparation of final plans for the Columbia River power project, costing perhaps $50,000. With this information it is believed that the people will have no difficulty in agreeing upon some definite irrigation and power policy for the state to pursue.

ELECTRICAL PUMPING AND IRRIGATION

DESIGN OF DIVERSION WEIR.

BY B. A. ETCHEVERRY.

The design of diversion weirs will depend on the type of weir and the local conditions, but there are static and dynamic forces common to all types of weirs. To consider these forces the weirs may be grouped into two classes: (1) those on impervious foundations such as bedrock not fissured, or on impervious clays; (2) those on pervious foundations of silt, sand or gravel.

Forces acting on weirs founded an impervious foundations.

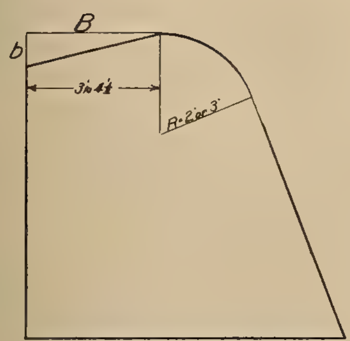
The dynamic forces are:

1. The erosive or scouring force on the downstream side of the weir produced by either the high velocity or by the impact of the water passing over the weir crest.

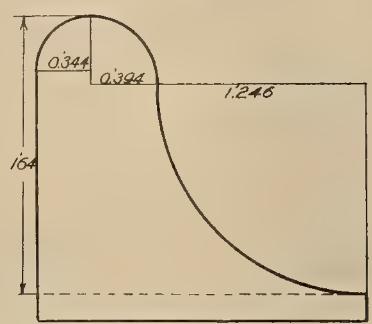
Downstream erosive or scouring force.

This force may act on the downstream face of the dam and also on the stream bed below. To resist it the following types of construction have been used, either singly or in combination:

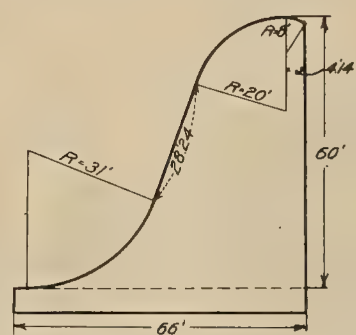
1. Use an Ogee face on downstream face of dam, to prevent impact of water.
2. Use a flat rollerway for the downstream face of dam.
3. Use a series of steps for the downstream face of dam.
4. Use a strong apron which will resist the impact and destroy velocity.
5. Use a water cushion into which the water falls.
6. Use an apron of riprap or paving to protect stream bed below.



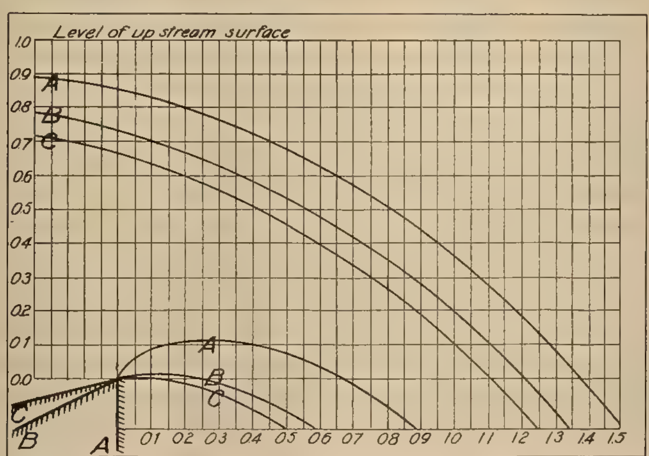
Typical Weir Crest for which coefficient formula is derived.



Bazin's Model of curved crest dam



Austin Dam, Texas.



Bazin Weirs
Profile of upper and under surface of sheet of falling water for varying inclinations of approach to weir crest, according to Bazin's experiments.

2. The force of impact of ice, trees, etc., on the upstream face of the weir.

The static forces are:

1. The normal water pressure on the upstream face.
2. The normal water pressure on the downstream face due to back water.
3. The weight of water supported by the crest.

Forces acting on weirs founded on pervious foundation.

The dynamic and static forces include in addition to those stated above the following underflow forces:

1. The transporting and erosive power due to the underflow in the stream bed under the weir floor.
2. The upward static pressure of the weir floor produced by the water under the weir.

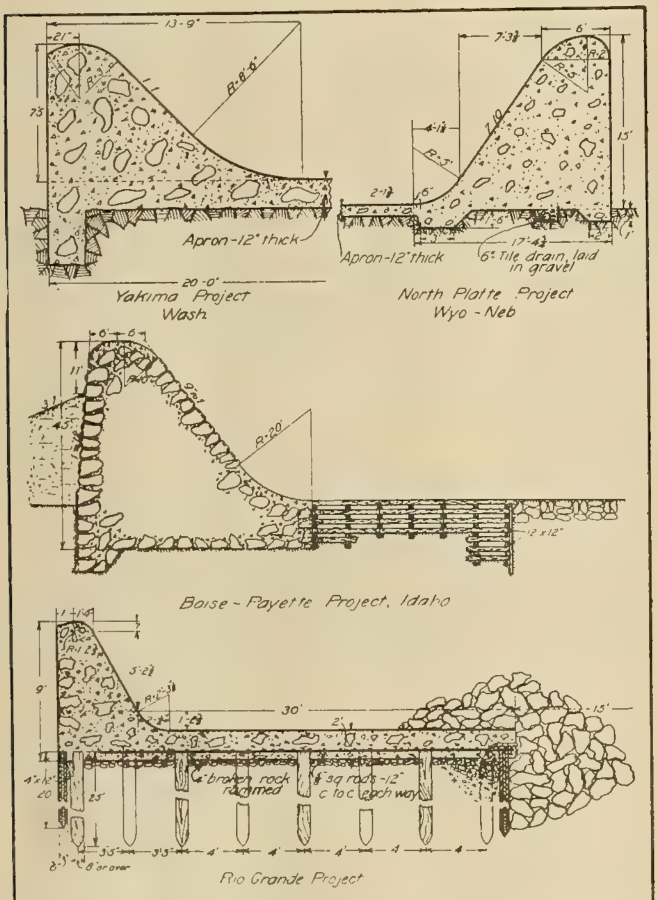
1st. Ogee Fall.

The object of an Ogee fall is to guide the water and give it nearly free fall down to a certain point and then make it flow on a curve so as to change the direction of flow gradually and discharge it parallel to the stream bed usually with a high velocity. The part of the downstream face, from the crest down to the point where the falling water changes its direction of fall, is made to fit rather closely the curve of falling water, being made flatter to prevent the formation of a vacuum under the sheet of water. The equation of the curve, which is a parabola, is

$$y = \frac{g}{2v^2} x^2$$

Where v = velocity of water over the crest at the crest y = ordinate corresponding to abscissae x, both measured from the origin of curve of falling water.

To determine the velocity (v) it is necessary to know the discharge and the exact water cross section (A) directly at the weir crest, when these are known $v = \frac{Q}{A}$. As the discharge Q and the length of weir crest are known for the case considered, the only remaining factor to be known is the depth of water at the weir crest. The depth of water obtained with the weir formula, generally used, is the difference in elevation between the weir crest and the water level measured at a point some distance upstream from the weir crest, before the water level begins to drop. From this point down the water level drops on a curve, so that the depth of water on the crest (D) is considerably less than the head of water (H) used in the weir formula.



OGEE DIVERSION WEIRS

The weir formulae most generally used are the following:

East Indian Engineer's formula:

$Q = CLH^{3/2}$ where $C = 3.4989 - .0535$ H.

This formula provides no correction for velocity of approach.

Bazin formula:

$$Q = (0.405 + \frac{.0984}{H})\ (1. + 0.55 \frac{H^2}{(p + H)^2})\ LH\sqrt{2gH}.$$

This formula considers velocity of approach.

Francis formula:

$Q = CLH^{3/2}$ (no velocity of approach).
$Q = CL\,[(H + h)^{3/2} - h^{3/2}]$ (with velocity of approach).

In the formula the following notation has been used:

p = height of weir in feet (used in Bazin's formula only).
H = measured head in feet or difference in elevation between weir crest and water level, at a point sufficiently far upstream to avoid the surface curve. A distance from the weir crest to the point of measurement equal to 2½ times the height of the crest of the weir above the bottom of the channel is recommended by Boileau.
h = head in feet corresponding to velocity of approach.
L = length of weir crest in feet.
C = coefficient of discharge.

Francis formula is the one most generally used in the United States. In this formula the value of the coefficient, which depends on the form of weir crest and depth of water, varies from about 2.5 to 4.5 and mostly between 3.00 and 4.00. The following formula has been deduced by U. S. Geological Survey for the coefficient for weirs of Ogee section, with 2 or 3 crest radius and upstream slopes 3 to 4.5 broad (page 131 Water Supply and Irrigation paper No. 200, U. S. Geological Survey.)

$$C = (3.62 - 0{:}16\ (S - 1)\ )\ H^{1/20}$$

Where S = batter ratio of the slope $\frac{\text{horizontal run}}{\text{vertical rise}} = \frac{B}{b}$

Measurements of discharge by the U. S. Geological Survey over an actual Ogee Dam, (Austin Dam, Texas) gave the following results:

Discharge coefficients for the Austin, Texas, dam:

H	D = depth at crest.	Ratio $\frac{D}{H}$	Average value of C
.42	.33	.79	3.112
.72	.625	.87	3.053
1.09	.838	.77	3.132
1.32	.96	.727	3.302
1.54	1.04	.717	3.333

With the above formulae, and value of discharge coefficient the value of H is obtained for any corresponding discharge. The value of D (depth of water directly on crest of weir) is required to find the velocity at the crest which will determine the equation of the parabola. The value of D as obtained by the measurements on the Austin Dam, expressed in percentage of the depth H, ranges from 87/100 for small depths of water to 71.7/100 for the larger depth of water. Measurements on curved crests of dams of similar form made by Bazin on small models give the following results for one of the most comparable models:

Head	Depth on crest	$\frac{D}{D}$
.305	.239	.78
.574	,433	.75
.820	.604	.74
.089	.820	.75

On the other models of curved crests the results obtained by Bazin are very nearly the same. (Annales des Ponts et Chaussees, Vol. 2, 1898, p. 151-264) Other measurements of profiles of the sheet of falling water are reported on pages 111, 112 of the U. S. G. S. Water Supply paper No. 200. On flat crests weirs, 6.56 and 6.89 ft. wide, and for maximum heads of

water of 5.15 and 4.65 ft. respectively, the ratio of $\frac{D}{H}$, where D is measured at the center of the crest was .61, for both weirs, and where D is measured at the downstream edge of the crest, the ratio was .43 and .45 respectively. For a flat crest dam 8.42 ft. wide (Cleggs Dam, North Carolina) Edwood Morris, for a head of 1.25 ft. obtained the ratio. 40.

As it is important, in order to prevent a vacuum under the sheet of falling, to determine the profile of the sheet of falling water for maximum flow condition when the curve is the flattest, it will be best to assume that the depth of water on the crest of an Ogee dam properly curved will be 65 per cent of the head H.

From the equations given above, we then have for the velocity at the crest:

$$v = \frac{Q}{A} = \frac{CLH^{3}/^{2}}{\frac{65}{100}\,L - H} = \frac{100}{65}\,CH^{1}/^{2}$$

and

$$y = \frac{g}{2\,v}\,2\,x^{2} = \frac{.21\,g}{C^{2}\,H}\,x^{2}$$

approximately,

$$y = \frac{6.75}{C^{2}\,H}\,x^{2} \qquad x^{2} = \frac{C^{2}\,H}{6.75}\,y$$

This equation for the parabolic curve is based on the average velocity of the water cross section at the crest of the weir. Adopting the well accepted principle, that the thread of mean velocity is two-thirds below the surface, the origin of the curve will be at a point directly above the crest at a height equal to 1/3 of the depth of water at the crest (or $\frac{D}{3}$). This curve, when plotted, will represent the thread of mean velocity of the falling sheet of water. The upper surface curve and under surface curve which form the boundary of the water sheet will be obtained by finding the thickness of the sheet at any point and plotting the points of the upper surface and under surface curve, at right angles to the mean velocity curve, at distance equal to 2/3 and 1/3, respectively, of the thickness of the sheet. The thickness of the sheet at any point is found from the discharge per lineal foot of crest divided by the velocity at that point which is the resultant of the constant initial horizontal velocity and of the vertical velocity due to gravity. ($\sqrt{2\,gy}$, where y = vertical distance below origin).

The profile of the sheet of falling water shows the shape which the upper part of the downstream face the Ogee dam must be given to prevent the formation of a vacuum between the sheet of water and the face of the dam. It is safer to flatten the profile of the dam so that it will extend well into the falling sheet; in some cases this is also necessary to satisfy the conditions of stability. To facilitate the construction of the Ogee curve, the downstream face is usually shaped by means of circular arcs and tangents, which are fitted to the theoretical profile. Where the vertical upstream face of the weir forms a right angle with the crest, there is full contraction of the under surface of the sheet of water, which causes, according to Bazin's experiments, a maximum rise in the surface equal to about ⅛ of the head of water at a distance of about ¼ of the head. This contraction is nearly eliminated by making a battered approach to the crest of the weir of 1 vertical to 4 horizontal. To eliminate this contraction, which will cause a vacuum, it is desirable to shape the crest of the dam with such a battered slope between the upstream vertical face of the dam and the summit of the weir crest, or to use a suitable curve which will fit this contraction. The profiles of the upper and under surface of a sheet of falling water, passing over a sharp edge crest, for a verticle crest and also for downstream inclinations of 2 horizintal to 1 vertical, and 4 horizontal to 4 vertical, as obtained by Bazin are shown in the accompanying diagram.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.

A meeting of the Society for Electrical Development, Inc., was held January 14, 1913, at the Engineering Societies Building, New York City. At this meeting the various work done by the organization committee was approved as were also the by-laws of the new society.

Immediately after the meeting of the society, a further meeting was held by the board of directors, who were selected by the associations which they represent from the various branches of the industry. The complete board is as follows, Mr. Doherty being elected president:

Henry L. Doherty	Gerard Swope	W. W. Low
Ernest Freeman	J. R. Strong	F. S. Price
A. W. Burchard	A. C. Einstein	Roger Scudder
W. H. Johnson	J. E. Montague	Earnest McCleary
J. R. Crouse	J. F. Gilchrist	P. N. Thorpe
W. E. Robertson	B. M. Downs	G. M. Sanborn
L. A. Osborne	W. A. Layman	

The first nine gentlemen compose the executive committee, on whom will lay the heavier responsibilities of the further organization work of the society. They have advanced sufficient funds for carrying out the organization work.

The society has the endorsement of the executive committees of the National Electrical Contractors' Association, the National Electrical Supply Jobbers' Association, the Executive and Public Policy Committees of the National Electric Light Association, together with the support of a large number of manufacturers, both large and small. With such endorsement there can be very little question of its practicability and value to the industry at large. The work of the society will be devoted to various lines of effort for the greater development of the electrical industry at large and will be carried out along broad gauge lines, aiming to increase in every way the uses of electricity, especially for light, heat and power.

The membership of the society as stated in the by-laws is open to every interest in the electrical industry and the subscriptions based upon a small percentage of the gross business are so small individually, that it is believed that the full co-operation of every concern in the electrical industry can be secured.

PROGRESS IN GENERATING UNITS.

Horizontal units are being built of 15,000 and 20,000 kilowatts capacity for speeds of 1800 r.p.m. and 1500 r.p.m., and even larger high speed units are contemplated. Single turbine generators of 30,000 kilowatts capacity for speeds of 1500 r.p.m. or 1200 r.p.m. for 25 cycle and 60 cycle service, respectively, are a possibility of the near future. Modifications of design have been offected whereby the materials used are not stressed materially harder than in smaller units.

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.
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CONTENTS

The Arbitrary Telephone Rate

Any attempt to fix an arbitrary rate by legislation without due attention paid to the fundamental principles of rate fixing involved, is clearly an erratic procedure which may prove unjust to all parties concerned. Even though such an arbitrary fixing may never be upheld by the courts, yet such an agitation jeopardizes the standing of the utility securities in a manner that is positively unjustifiable. In practically every commonwealth of the West, regulating commissions have been fully empowered to handle such issues in a reasonable manner wherein rates may be determined according to scientific methods just both to people and utility company alike.

Some over-zealous citizens of San Francisco propose to legislate a flat rate for telephone service. Such procedure can but wrongly injure the securities of a great utility without accomplishing good.

The issue is clear. So much actual invested capital is represented in the telephone securities. On this money the utility is entitled to a reasonable return and the people, in exchange, are entitled to an adequate service. Regulating commissions throughout the West should get at the true status of affairs and, knowing the true status, act with the strong arm of the law. For common justice to all it would seem, then, that the commissions ought at once to get busy. Neither an excited public opinion nor a possible influencing corporate interest should in any manner be suffered to alter a result which may be determined with scientific accuracy.

The question of telephone rate-fixing is not one of local interest. Its sphere of action is nation-wide. The recent movement of the United States Attorney General in directing the Interstate Commerce Commission to investigate telephone rates will indeed be awaited by all with the keenest interest.

The Dangers of the Company Section

The acquiring of knowledge is a subtle phenomenon. The patient and the studious absorb without prodding, while many devoid of outward studious appearances nevertheless, by god-given powers of observation and application, soon become masters in theory and practice. Such, however, are the exceptions. Knowledge to be generally disseminated must be presented in such a manner that the words of wisdom fall upon willing ears.

The symposium, or the intellectually drinking together of congenial spirits, is indeed the acme of methods to be employed in the dissemination of useful knowledge among the employes of the modern utility company. A collection of comments or opinions thus brought together becomes invaluable. Especially is this true where several brief essays or articles are contributed on the same subject by different writers, engaged in similar work but occupying varying fields of experience. The specialized activities of the day call for experiences compiled from an ever widening field of action. Often, for instance, in one district of an hydroelectric network, serving many communities, an intricate problem is encountered in distribution which may at once be solved by applying methods that were used in solving identically the same problem in an-

other portion of the same system. A symposium of all engaged in directing the distribution of the company thus makes impossible the reduplication of effort.

The monthly managerial conferences now instituted in practically all the larger utility companies of the west are indeed immeasurably simplifying the titanic burdens of utility action. Now comes the second stage of conference—that in which the technical employes are invited to gather in monthly meetings for the discussion of technical subjects involved in the various phases of their work. Such sections may prove of immeasurable benefit to a utility, not the least of which will be found in expanded loyalty for the utility they serve. Two dangers, however, should be carefully guarded against: a tendency which may tend to narrow or inbreed and again, a possible feeling of compulsion in attendance by the authorities of the company.

The first danger arises from the fact that a technical organization composed of only company members is familiar with experiences of its own creation alone and may be lacking in the broadening influence gained by association with those working along parallel lines in other utility companies. Such an influence may become narrowing and result in what stockmen call "over in-breeding."

Again a delicate point is to be handled in regard to the feeling of the management toward attendance. Fifty per cent of the resulting good is lost when a member must feel that his attendance is anything but optional. The member must feel that although the executives are anxious to build up technical discussion among the employes still there must be a reasonable latitude within which the technical employe must have full and complete freedom from duty. In a word recreation and not fulfillment of duty should hold his constant attendance.

To prevent both these deadening influences from being felt the program committee should exercise considerable sagacity in the choice of leaders in discussion and in the selection of topics. An occasional speaker from an outside or competing company will do much to broaden the general atmosphere. On the other hand the selection of live interesting questions for discussion will bring the member at the meeting without any further pressure. His horizon is thereby numerically widened and keen interest holds the punctual attendance.

The Efficacy of Demonstration

Every competent salesman follows six general steps in consummating a sale. First, there is the opening chat which wins the prospect's attention and prompts him to look further into the proposition offered. Then comes the lucid description and explanation which still further gains the prospect's interest by picturing the proposition in his mind. On the heels of this lucid, specific description, argument or proof follows, which creates a desire for the article that the salesman has to sell by showing its value and advantages. Then comes the subtle persuasion of the gifted salesman which draws the prospect to his way of thinking by showing the adaptation of his particular make of article to the needs of the prospect and that the prospect needs it now. The fifth step is the inducement offered which gives the prospect a particular or extra reason for buying. And, finally comes the climax or clincher, which by its subtle psychological effect, makes it easy for the buyer to order and prompts him to act at once.

Any abrupt procedure in the steps outlined above often proves fatal. The psychology of salesmanship is indeed delicate in operation. Interest—live, understanding interest—kept alive throughout the alert argument of the salesman is a wonderful aid in netting returns.

In the selling of electrical goods to the layman, a lack of knowledge of the actual appearance and workings of a particular appliance kills many a desire to purchase existing in the mind of a buyer. Electrical devices at best are not generally understood. Wide-awake central station managers have in recent months fully evidenced their convictions on this point. This is seen on all sides in the attractive show counters and windows maintained by them so that patrons may be fully educated in modern electrical conveniences.

Not only have the central stations awakened to the efficacy of demonstration but the jobber who wholesales his equipment has also come to a keen realization of its possibilities. Our leading article of this issue is devoted to a description of the new home of one of the largest electrical jobbing houses on the coast. The structure is indeed a masterpiece of forethought looking to results to be anticipated from forceful presentation, accomplished by exhibiting standard products actually installed throughout the building.

The passerby is first attracted by looking into the main display, which fronts on one of the principal streets of a great city. Many forms of modern electrical appliances are seen from the window, installed in various parts of the room. This entire exhibit is raised to meet the convenient glance from the observer. Hence there is no show window proper, for the entire room itself is thus made to act in this capacity. Upon entering, the interest of the prospect is at once aroused by observing in minute detail the particular article desired. If interested, for instance, in bushings, or various types of wiring, all standard makes carried by the firm may be observed actually installed in various parts of the edifice. On the other hand, should electric appilances be the thing in which the prospect is most interested, not only may they be seen in profusion in the several display rooms but the company has installed a complete equipment in the suite of rooms used by its women employes during the recreation hours of the day. Automatic elevators, both freight and passenger, bespeaking the last word in invention, may also be seen in operation and inspected in every detail. Indeed the entire equipment from fuse blocks to automatic fire sprinklers is a remarkable accomplishment and emphatically voices the power of demonstration.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Ralph D. Mershon, president of the American Institute of Electrical Engineers, is at San Francisco.

L. C. Lull has been elected president of the A. I. E. E. student branch at Stanford University, California

H. E. Plank, steam turbine expert with the General Electric Company, has returned to Portland from San Francisco.

R. W. Bigelow Jr., vice-president of the Acme Electric Heater Company of Detroit, Mich., is visiting the trade at San Francisco.

E. R. Whitney, sales engineer with the General Electric Company, has returned to Portland from a month's trip to California.

Gustav Wade, a recent graduate of Stanford University, is now with the Yakima Valley Transportation Company, at North Yakima, Wash.

W. W. Hanscom, consulting electrical engineer at San Francisco, has been appointed alternate statesman of the Jovian Order for California.

C. E. Allen has been appointed assistant manager of the detail and supply department of the Westinghouse Electric & Manufacturing Company, at East Pittsburg, Pa.

N. I. Garrison has arrived at Stockton, California, to assume his duties as auditor of the Western States Gas & Electric Company. For eight years he was auditor of the Fort Smith Light & Traction Company.

E. B. Strong, president of this journal and Pacific Coast master of transportation for the N. E. L. A. convention at Chicago in June, 1913, is attending the meeting of the transportation committee at New York City.

J. W. E. Taylor, formerly with the engineering department of the Great Western Power Company, has joined the engineering staff of the Oro Electric Company at San Francisco and will have virtual charge of engineering operations.

Charles F. Scott has been appointed first vice-president of the A. I. E. E. executive committee on organization of International Electrical Congress at San Francisco in 1915, this appointment following the resignation of **W. D. Weaver.**

Henry A. Lardner, Pacific Coast manager for J. G. White & Company has been transferred to the grade of Fellow in the American Institute of Electrical Engineers, **Charles F. Conn**, of the same company, having been transferred to the grade of Member.

M. M. O'Shaughnessy, City Engineer of San Francisco, and **A. W. Maltby** have been selected by the Department of the Interior as Commissioners to decide the dispute between the Reclamation Service, Lake Tahoe property owners and the Truckee River General Electric Company, concerning the diversion of waters from Lake Tahoe.

T. E. Fogelsang, formerly superintendent of the Pacific Gas & Electric Company's Station A at San Francisco, has been appointed assistant manager of the company's operation and maintenance department, steam section. **C. A. Eastwood** has been made superintendent of Station A. **J. W. Varney** has been placed in charge of Stations E and H, in addition to the other substations of which he is superintendent.

Philip S. Dodd has resigned as director of the commercial development department of the National Quality Lamp Division of the General Electric Company to accept the appointment of secretary-treasurer of the recently organized Society for Electrical Development, Inc. **J. M. Wakeman** has been appointed general manager of the Society. Both Mr. Dodd and Mr. Wakeman are well known in the electrical industry and have a most intimate acquaintance with publicity problems of the kind involved in the present propaganda on behalf of electrical development.

IN MEMORIAM.

In the death of Prof. T. S. C. Lowe, at Pasadena, Cal., on Thursday, January 16, 1913, the world has lost one of its greatest scientists, whose inventions have benefitted millions of people. He made many fortunes and spent them all in the development of epoch-making discoveries which were potent factors in the advancement of civilization. Professor Lowe was a genius of giant intellect, whose ideas were far in advance of his time, and the world is better for his having lived in it.

Born in Jefferson, New Hampshire, August 20, 1832, his boyhood days were spent among the hills of New England, where his talent for invention early developed. He claimed to have but a common school education, but it might better be said that he learned those things which he needed to know, for in later life he had a profound knowledge of the sciences beyond the scope of teachers. His mind seemed to have a power like the Roentgen Ray for penetrating the mysteries of nature's forces, which were opaque to the mind of his contemporaries.

His earliest work was in the field of aeronautics and in 1860 he constructed the largest balloon ever made (The Great Western), its capacity being 725,000 cubic feet of gas. This work was prompted by a belief that the study of the air currents would lead to some method of forecasting the weather, and was the germ which eventually developed into the present United States Weather Bureau. His balloon ascensions confirmed his belief in the existence of an upper air current, invariably flowing in an easterly direction.

During the war he offered his services to the Government and made nearly three thousand ascensions. He invented a system of signalling from the air and also the aerial telegraph. He served through the campaigns from Bull Run to Gettysburg and eminent military strategists have given him the credit of having turned defeat into victory by his skill and bravery.

Immediately following the war he invented the first artificial ice machine and applied the invention to the refrigeration of rooms, and he equipped the first vessel used as a refrigerator ship. This was in 1866, and the value of the invention was so little understood that not until long after the expiration of his patents for the process of ice-making did the world awaken to its wonderful possibilities. All of the present systems of refrigeration and artificial ice-making were anticipated by Prof. Lowe's genius and are built on the foundation which he so ably prepared.

A history of his life would be a continuous chronicle of surprising discoveries and useful inventions culminating in 1873 with the crowning achievement of his career, a method of manufacturing water gas. The vast economies resulting from this invention and its application to the pressing needs of the world for heat and light, placed the name of Lowe among those of the few great scientists who have done things for humanity that will never die.

Prof. Lowe made a justly deserved fortune from his water gas inventions, but all of this wealth was used in the construction of the Mt. Lowe Railway and the establishment of the Lowe Astronomical Observatory in Southern California.

On June 16, 1894, Prof. Lowe was elected an honorary member of the Military Order of the Loyal Legion of the United States in recognition of valuable services rendered by him to the Government during the war for the suppression of the rebellion. Prof. Lowe was a charter member, and the first honorary member of the Pacific Coast Gas Association, having been unanimously raised to the position of honorary member on July 17, 1901. He was beloved by his friends. The seeds of wisdom he planted will never die, and the monuments erected by his genius will make his name immortal.

E. C. JONES.

January 21, 1913.

MEETING NOTICES.

Seattle Section, A. I. E. E.

The January meeting of the Seattle Section was held Saturday evening, January 18th. A paper on "Electric Welding" was presented by Mr. W. M. Price, giving a review of the various systems in successful use, together with operating information and cost data.

Electrical Jobbers.

The next meeting of the Pacific Coast electrical jobbers will be held at Del Monte, Cal., February 27, 28 and March 1. This will be one of the most important meetings ever held, General Secretary Franklin Overbagh and General Counsel Thomas Debevoise being expected to be present.

San Francisco Jovian Club.

A large and enthusiastic luncheon of the San Francisco Jovian Club was held at Tait's cafe on January 21st. Aside from the usual routine business a spirited discussion was held on the question, "Resolved that it is for the good of the Jovian Order that a limited amount of wine be served at rejuvenations." The negative was so vigorously upheld by W. L. Goodwin and A. E. Elliott that the substitute speakers on the affirmative, G. I. Kinney and A. H. Halloran, finally added their arguments and votes to make the decision unanimous in condemning the use of any liquor at rejuvenations. Announcement was made of the plans for the reception and entertainment of Frank Watts, National Jupiter, upon his arrival at San Francisco on June 3. A. M. Alvord, presided. Talks were also given by T. E. Bibbins and H. V. Carter on the high standard now set by the Jovian Order

Oregon Technical Club.

The Oregon Technical Club luncheon on January 14th was presided over by H. R. Wakeman, chairman of the local section of the A. I. E. E. The speaker of the day was L. B. Wickersham, chief engineer of the United Railways. His subject was "Water Resources of Oregon and Railway Electrification of the Willamette Valley."

He gave a brief summary of the water powers of Oregon and stated that the "Clear Lake development" of the Hill interests was one which promised to be a very interesting one, the availabe head being 1100 feet and the amount of water 300 to 400 second feet. The speaker made it very clear that Oregon led all the States of the Union in 1912 in the amount of interurban electric railway trackage installed, there being laid in the year 1912 eight-five (85) miles of interurban track, electric Pullman service being now maintained between Portland and Eugene, at night sleeping accommodations being provided. He also paid a glowing tribute to 1200-volt d.c. systems for interurban service.

NEWS OF THE SAN FRANCISCO ELECTRICAL CONTRACTORS.

Geo. H. Duffield, special representative of the National Electrical Contractors' Association, has been in San Francisco for the past week calling on members of the National Association, keeping them in touch with the work the National organization is doing to place electrical contracting on a higher plane and to improve trade conditions. He also is explaining the literature and data furnished by the National to its members, which is really a tangible benefit of membership.

The California State Association of Electrical Contractors will hold its annual meeting at Santa Barbara, Cal., August 13, 14, 15, 16, 1913.

The annual election of officers was held by the S. F. D. L. No. 1, C. S. A. E. C, and the following were elected to serve for the year 1913: C. F. Butte, Butte Eng. & Elec. Co., President; L. R. Boynton, Central Elec. Co., Vice-President; W. S. Hanbridge, Secretary-Treasurer; W. D. Kohlwey, W. D. Kohlwey Company, Sergeant-at-Arms. The members then listened to an instructive address given by Mr. Chas. Wiggin of the Dunham, Carrigan & Hayden Company, on the subject of Credits. Mr. Wiggins was well able to handle the subject, as he has been connected with the contractors, jobbers and manufacturers for many years. Mr. Albert Elliot has been selected by the State License Committee of the California State Association of Electrical Contractors to draft and take care of a State license law, a copy of which will appear in the next issue of the Journal.

TRADE NOTES.

The Tacoma Wood Pipe Manufacturing Company, Tacoma, Wash., has succeeded the Tacoma Wood Pipe Company. B. O. Skewis is manager.

Mathias Klein & Sons have made arrangement to manufacture and market the "Eichhoff Line-builders Wire Reel." The reel combines a take-up and pay-out reel in one.

The San Francisco offices of the Bryant Electric Company have been moved from 609 Mission street to more convenient and commodious quarters in the Greenwood Building, at New Montgomery and Minna streets.

Westinghouse, Church, Kerr & Co. are acting as engineers and constructors for John Coughlan & Son in Vancouver, B. C., in the design and construction of a pile pier 690 x 60 ft. and a structural steel shop of timber 360 x 55 ft., with crane runway, together with heating, lighting and plumbing facilities.

The Standard Underground Cable Company of Canade, Ltd., has established new branch offices at Montreal, Quebec, and Winnipeg, Manitoba, in order to facilitate the prompt handling of their growing business. Business originating in the province of British Columbia and Alaska and Yukon Territories will be handled by the Seattle, Wash., office of the company, and business from the Maritime Provinces will be handled by the Boston, Mass., office. This is a temporary arrangement in order to secure prompt service immediately for customers in those districts until the volume of business justifies the establishing of separate offices in the Dominion. The establishment of these branch offices puts the Standard Underground Cable Company of Canada, Limited, in an excellent position to handle with accuracy and dispatch all business which they may secure.

The Salt River Valley Water Users' Association of Phoenix, Arizona, have recently contracted with the Pelton Water Wheel Company to furnish from their San Francisco shops all of the hydraulic apparatus for the "Cross Cut" power plant near Tempe, Arizona. This involves six vertical 1000 h.p. Pelton-Doble tangential water wheel units to be direct connected to Westinghouse alternating current generators, vertical type. Also two 300 h.p. vertical shaft Pelton-Doble impulse units for direct connection to the exciters. The operating head will vary from 117 to 120 ft. and the water will contain at times considerable salt and more or less sediment in suspension. The rotating speed for the vertical alternating wheel units is 94 r.p.m. Because of the comparatively low head and the unit size of the machines, this slow speed was decided upon by the engineers and will necessitate several nozzles each discharging upon a single Pelton-Doble runner for each unit. The hydraulic machinery of this particular power plant will involve a number of new and novel features and the Pelton Company's arrangement was found to be the best adapted to these particular conditions where it was necessary to minimize the damage from salt and silt in the water, and to insure continuous operation. Otherwise, turbines running at a much higher speed could have been employed, resulting in a lower first cost for the installation.

NEWS NOTES

ILLUMINATION.

MARYSVILLE, CAL.—The Oro Electric Corporation has been granted a 50-year franchise in the county of Yuba.

OLYMPIA, WASH.—The Wilbur B. Forshay Company's application for an electric light franchise has been denied.

EI SEGUNDO, CAL.—Sealed bids will be received up to January 27th for installing necessary equipment and lighting with electric lights certain streets in El Segundo.

PORTERVILLE, CAL.—Officials of the Central California Gas Company have made application for a franchise to lay their distribution pipes along various county roads.

LA MESA SPRINGS, CAL.—The San Diego Consolidated Gas & Electric Company has secured right of way from East San Diego to La Mesa, and will commence work in the near future to install a 4-inch high pressure gas main.

NEW WESTMINSTER, WASH.—The city council has entered into a contract with the British Columbia Electric Railway Company for a supply of electric current to the city for eleven years. The company named will build a new substation at Sapperton.

VANCOUVER, WASH.—The two franchises asked by the Northwestern Electric Company, one to operate a street car line and another to run a light and power company, were laid over by the council and will be acted upon at a special meeting to be called some time in the near future.

PORTLAND, ORE.—State Senator Isaac N. Day will introduce a bill in the state legislature providing for developing of approximately 100,00 h.p. by harnessing the Columbia River above Celilo Canal, the project to be prosecuted and operated by the states of Oregon and Washington, for the benefit of municipalities tributary to the river.

STOCKTON, CAL.—The Stockton Gas & Electric Corporation's first mortgage, 6 per cent bonds of the issue of 1909, due 1934, have been called for payment on January 1, 1914, the first callable date under the mortgage, at 105 and interest, at the Mercantile Trust Company. The trust company will pay any of said issue at 106, if presented before January 1, 1914.

KELSO, WASH.—The Washington-Oregon Corporation has been granted a franchise over the county roads from Kelso to Castle Rock on the west side of the Cowlitz River for the construction of an electric line for power and lighting purposes. B. H. Atkins, local manager for the Washington-Oregon, states that work will go ahead at once on the construction of this line.

SPOKANE, WASH.—Extensions and improvements by the Spokane Gas Company contemplated for 1913 and already under way, call for an expenditure of $120,000. A. N. Cantrill, manager of the company, announced the letting of the contract of $20,000 for electrifying the steam-driven machinery at the gas plant. The contract for electrical energy goes to the Washington Water Power Company.

TRANSMISSION.

PITT LANDING, B. C.—The Western Canada Power Company will erect a steel tower on the south side of the Canadian Pacific railroad tracks here.

TACOMA, WASH.—The Chicago, Milwaukee & Puget Sound Railway will build a power house on the tide flats at a cost of $5000. Work will be done by the company's crews.

REDLANDS, CAL.—Engineers of the Edison Company are preparing surveys for building a high power line from Redlands to Yucaipa valley, work to start at once, as company has contract to furnish power by March 1st.

THE DALLES, ORE.—Announcement has been made by the Pacific Power & Light Company for a plan of materially increasing the power developments at Hood River and work will soon be underway on a new 700 horsepower plant which will cost approximately $500,000. This plant will be located a short distance above the O. W. R. & N. bridge at Hood River and almost within the city limits.

SALT LAKE CITY, UTAH.—An application has been filed with the state engineer for the appropriation of 2370 second feet, 1,715,000 acre feet of water daiiy from the Green River for power purposes. The application was filed by Thomas W. Cameron, Theodore J. Winkelar, Frank D. Wyant and other St. Louis capitalists. They plan to organize a power company to distribute power throughout Utah.

WALLA WALLA, WASH.—Plans for a 2000 horsepower hydroelectric power plant to be built on the Walla Walla River seven miles above Milton, Oregon, are being made by Milton men, who own Walla Walla River land. The men interested in the company are: C. E. Demaris, Amos Demaris, Harry Huber, John Ross, J. A. Hayton, Henry Hopkins, Jake Demaris, Sherman Mizer, H. Rhuberg, Chas. Heathington, C. Wallace and N. T. Manola.

LOS ANGELES, CAL.—An amended offer to purchase on a meter basis all of the power that may be generated by the aqueduct power plants has been submitted to the city council by the three local power companies. Recently the city authorities turned down the offer of the companies to pay the city annually $1,000,000 for 35,000 electrical h.p. The amended offer is to the effect that the companies will enter into a contract with the city for the purchase of all the electrical h.p. about to be developed by the city at its proposed power house delivered at the city's substation or substations in Los Angeles in quantities as needed by the consumers upon the companies' systems, and that the companies will pay to the city therefore the sum of 65-100ths of a cent per kw-hour meter measurement. Under such a plan, and on the assumption that the average load would be about 17,500 electrical h.p., it is estimated the revenue that would be derived by the city would be approximately $750,000 annually.

TRANSPORTATION.

SEATTLE, WASH.—The city council proposes to issue additional bonds to the amount of $600,000 for extensions of the municipal car line.

OGDEN, UTAH.—The Ogden Rapid Transit Company has been granted a franchise for the construction and operation of a railroad over a certain portion of the Ogden Canyon road.

SAN FRANCISCO, CAL.—From Visalia it is reported that the route of the proposed extension of the Visalia Electric Railroad from Redbanks to Fresno has been surveyed for some distance from the present end of the line.

MEDFORD, ORE.—O. C. Boggs, attorney, here, representing the Barnum interests, has filed with the city recorder an ordinance asking for a franchise to operate an electric line in this city. A deposit of $25,000 has been made.

ALBANY, ORE.—From an authentic source comes the information that the Portland, Eugene & Eastern Railway Company will build a passenger depot here shortly. Superintendent T. L. Billingsly, of the company, will not confirm or deny the report.

RICHMOND, CAL.—The San Francisco-Oakland Terminal Railways Company has been awarded a franchise for a street car line on Ashland avenue from Macdonald avenue to the extension on Standard avenue, along Ashland avenue and from that point south to Richmond avenue.

SEATTLE, WASH.—E. M. Mills, representing bondholders and creditors of the Seattle, Renton & Southern Street Railway Company, has applied for three franchises for extension to the present system in Rainier Valley. The application has been referred to the city utilities and franchise committee.

HARLOWTOWN, MONT.—The Chicago, Milwaukee & Puget Sound Railway Company has been granted permission to electrify 450 miles of road between this city and Avery, Idaho. Power will be supplied by the Great Falls Power Company, Great Falls, Mont. It is reported work will begin at once.

ALBANY, ORE.—The Corvallis & Eastern Railway plan the following improvements to be made during the coming spring and summer: A 35x200 ft. car shop, a 24x100 ft. store room and a 20x30 ft. addition to machine shop. A large steam boiler, one or more electric motors, turning lathes, etc., will also be installed. Master Mechanic D. M. McLaughlin will have charge of the work.

SAN FRANCISCO, CAL.—By an agreement between the United Railroads and the Supervisors' finance committee relating to the percentage of receipts which the railroad should pay for secondary lines the city gained $800. Approximately $39,000 was due the city for 1911 receipts under the old arrangement, which provided that secondary lines should pay 50 per cent of what was paid for primary lines.

BURLINGAME, CAL.—F. J. Rodgers, manager of the electric railway project headed by A. M. Easton, states that if the line now under construction proves a success applications will be made to the city trustees of Burlingame for more franchises. Work on three miles of railroad was commenced several days ago. The type of car to be used on the new line is the Edison-Beach storage battery car. Mr. Rodgers says that a 15 minute service will be maintained on the new railway.

SALT LAKE CITY, UTAH.—Extensive purchases of property on West Temple, First West and Pierpont streets, have been made for the Bamberger and the Orem interests, controlling the Salt Lake and Ogden Railway and the projected Salt Lake and Utah Railway. The purchases have been made largely for the purpose of providing terminal facilities for the two electric lines, which are planning a joint depot at West Temple and Pierpont streets. The line of the Salt Lake and Ogden Railway will be extended either from its present terminus at Third West and South Temple streets, or from another point farther north to Pierpont and First West streets, and will run on Pierpont street through the block to W. Temple street, looping around the corner on W. Temple to Second South. The Salt Lake & Utah Railway, the southern terminus of which will be Payson, will enter Salt Lake in the western part of the city, coming along First West street from the south to Pierpont street, where its cars will use the same tracks as those used by the trains of the Salt Lake and Ogden Railway. Plans contemplate the looping of the Salt Lake and Utah Railway south on W. Temple street to Third South and thence west again. The property purchased jointly by the two railroads includes the Menzies property on W. Temple street between the Dooly block and Pierpont street.

TELEPHONE AND TELEGRAPH.

BURLINGTON, WASH.—The Independent Telephone Company is planning on improving its service here. Work will begin shortly.

SEATTLE, WASH.—The city council has an ordinance before it for a bond issue of $2,000,000 for a municipal telephone system.

ALPINE, TEXAS.—The Pecos & Rio Grande Telephone Company is preparing to install a direct copper line to Marfa. They also expect to put all the Alpine phones on a metallic circuit.

VICTORIA, B. C.—The British Columbia Telephone Company will extend a new line from this city to Nanaimo. The cost is approximately $15,000. C. F. Bollschweler, here, is superintendent of construction.

CENTRALIA, WASH.—The U. S. government has been granted a franchise by the Lewis county commissioners for a telephone line from Lake Creek to Randle, a distance of 25 miles. The line will be used by the forestry service.

CENTRALIA, WASH.—The county commissioners have granted a telephone franchise to the Cougar Flats Telephone Company, Wm. Booth, president. The line will be connected with rural lines in eastern Lewis county and will be built at once.

LOS ANGELES, CAL.—Bids will be received up to February 18th, for a franchise granting the right to erect and maintain poles, wires, appliances and conduits for the transmission of electricity for telephone and telegraph purposes in Vernon, Cal.

SAN ANDREAS, CAL.—Application has been made for a franchise to maintain a telephone, telegraph and electric power line from the city of Angels to the home and mining claim of Desire Fricot in Calaveras county. Sealed bids will be received up to March 3 for the sale of the franchise.

SAN DIEGO, CAL.—The Pacific Telephone & Telegraph Company is planning to erect a $40,000 substation on University avenue, between Sixth and Seventh streets. According to J. E. Franklin, local manager of the company, the new station will entail an outlay of approximately $138,000.

BAKERSFIELD, CAL.—Application has been made for a franchise granting the right for a period of 50 years to operate and maintain a pole and wire line for telephone purposes along certain public roads in Kern county. Sealed bids will be received up to February 10th for the sale of the franchise.

BISBEE, ARIZ.—Under supervision of Forest Ranger MacBeth, the United States government is building a telephone line into Patagonia from Temporal Gulch, which will connect the Mountain States line at Arivaca. Steps are under way to connect up a loop from Duquesne to Mowry, a distance of five miles, which will give Patagonia another outlet by way of Nogales.

LOS ANGELES, CAL.—Announcement has been made that the Pacific Telephone & Telegraph Company will acquire the Imperial Valley Telephone Company, negotiations having been under way for some time. After the deal is completed, the Imperial Valley Telephone Company's lines will be placed under the jurisdiction of the Pacific company. The company has about 1000 phones.

LA GRANDE, ORE.—Asserting that the rates charged by the Eastern Oregon Co-Operative Telephone Association, of Elgin, since its organization about a year ago, are unjust to competitors, discriminatory as to some of its subscribers and preferential as to others, entirely insufficient to meet its operating expenses, and that if it is allowed to continue its present rates and practices, the entire telephone industry in the local and neighboring communities will be demoralized, the Home Independent Telephone Company of La Grande has filed a lengthy complaint with the Railroad Commission of Oregon.

PORTLAND, ORE.—The government is taking an interest in the effort of the Pacific Telephone & Telegraph Company to acquire the Northwestern Long Distance Telephone Company of Oregon and Washington, under foreclosure proceedings recently commenced in Portland. When the foreclosure suit was brought complaint was made through the United States district attorney at Portland to the Washington officials that the Pacific company was seeking a monopoly of the telephone business in California, Oregon and Washington. It was shown that the Home Telephone Company of Tacoma and Bellingham and the Independent Telephone Company of Seattle, already had been acquired. The government now is seeking to ascertain whether there is evidence of restraint of trade in these combinations.

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Wire, Enameled.
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General Electric Company
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Standard Und. Cable Co.
Western Electric Company

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General Electric Company
Habirshaw Wire Company
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Bridgeport Brass Company

Wire, Weatherproof
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VOL. XXX NO. 5 — SAN FRANCISCO, FEBRUARY 1, 1913 — PER COPY, 25 CENTS

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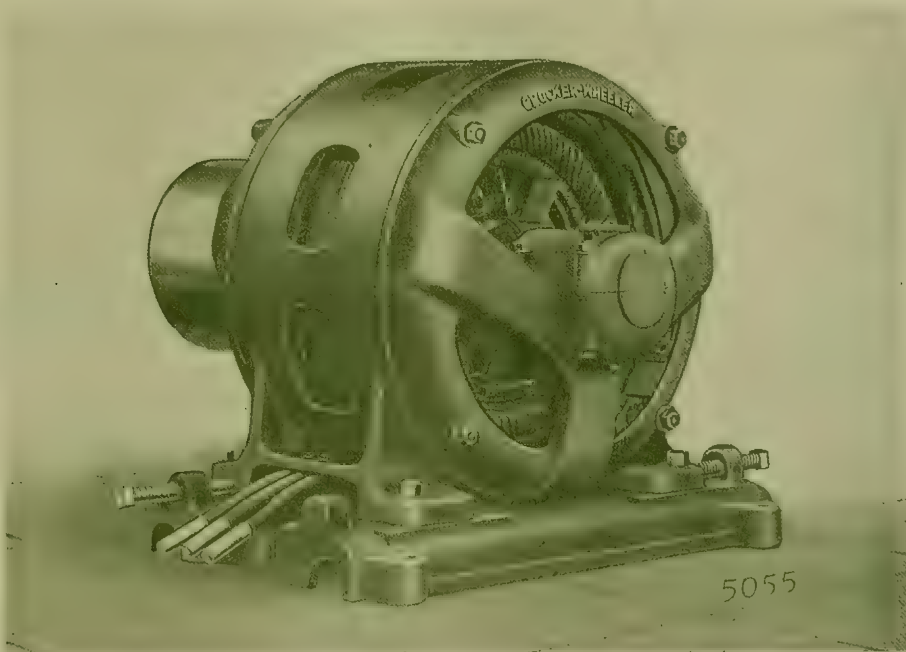
For Operating on 60-Cycle Polyphase Alternating Current Circuits



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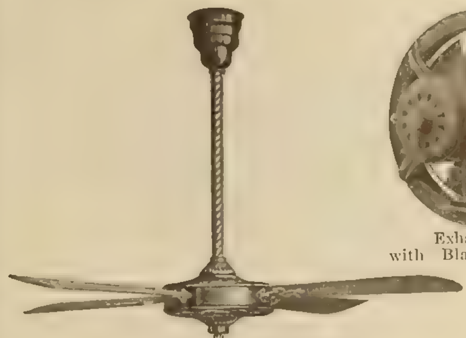
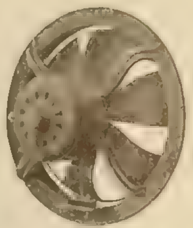
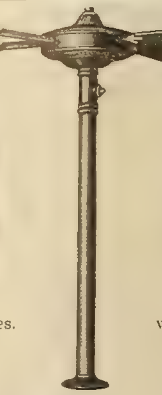
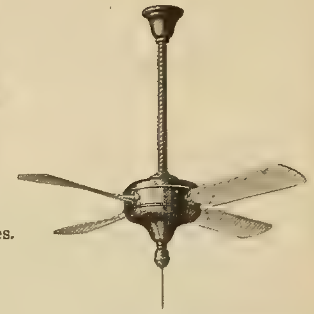

Alternating Current 56-inch Ceiling Fan.

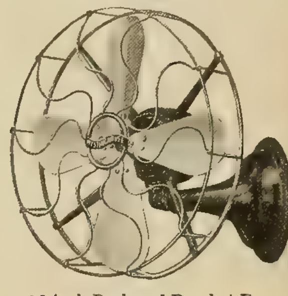

Exhaust Fan with Blackman Blades.


Alternating Current 56-inch Counter Column Fan.

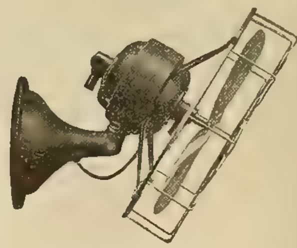

Exhaust Fan with Westinghouse Blades.

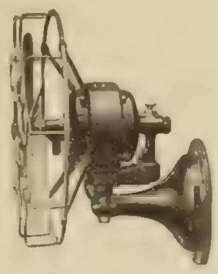

Direct Current 32-inch Ceiling Fan.


12-inch Residence Fan.


16-inch Desk and Bracket Fan Bracket Position.


12-inch Mechanically Operated Oscillating Fan.


12-inch Desk and Bracket Fan Bracket Position.


12-inch Mechanically Operated Oscillating Fan, Bracket Position. No Adaptor or Tools.


12-inch Air-Operated Oscillating Fan.

We have been looking forward to the 1913 Electric Fan Season

We recognize that electric fans are no longer a luxury but a business and household necessity, and have made our plans accordingly. Good judgment dictates handling a make of fans that embodies a complete line of unquestioned quality, backed by manufacturing facilities guaranteeing prompt deliveries.

Westinghouse Electric Fans

The unqualified success of Westinghouse Drawn-Steel-Frame Fans last year, in spite of a cool summer, foretells an unusually heavy demand the coming season. This has been anticipated by increased manufacturing facilities and by making provision for carrying larger stocks than ever of all types at all important centers. Westinghouse Fans include the following styles for operation on all commercial alternating and direct current circuits:

Desk and Bracket	8-inch, 12-inch, 16-inch	Telephone Booth—8-inch.	
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Air-Operated Oscillating	12-inch, 16-inch	Exhaust Fans	12-inch and 16-inch Blackman Blades; 12-inch and 16-inch Westinghouse Blades

Send for Art Circular 1165, Folders 4100 and 4101, Flyers 4232 and 4244, and other advertising helps.

Westinghouse Electric & Mfg. Co.,
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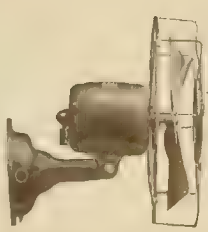
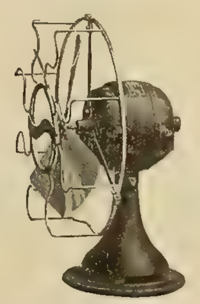
8-inch Desk and Bracket Fan Series Motor


8-inch Desk and Bracket Fan Bracket Position.


Telephone Booth Fan.


8-inch Desk and Bracket Fan Induction Motor.

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DATA ON ELECTRIC COOKING AND HEATING

BY BEN M. MADDOX.[1]

The circuits of the Mt. Whitney Power & Electric Company cover the greater part of the valley section of Tulare County, and a small portion of the northern end of Kern County, in California. A large proportion of the territory is devoted to the growing of citrus fruits and the balance to alfalfa and deciduous fruits. The ditch irrigation system is not extensive, and as a result a great deal of the land is irrigated by pumping from wells by electrically driven pumps. The pumping load has developed to such an extent as to become the main business of the company. With a load of that character the demand on the system is heavy during the summer, and much lighter during the winter and spring.

For several years the management has been in search of something to fill in the valley during the winter months, this being a hydroelectric plant, such a load would be very desirable. After thorough investigation, it was decided that electric heating would answer the purpose. It seemed advisable to also encourage electric cooking, as it would produce a good revenue continually, thus making more profitable the investment in transformers and lines necessary to serve the heaters.

The next step was to determine a satisfactory

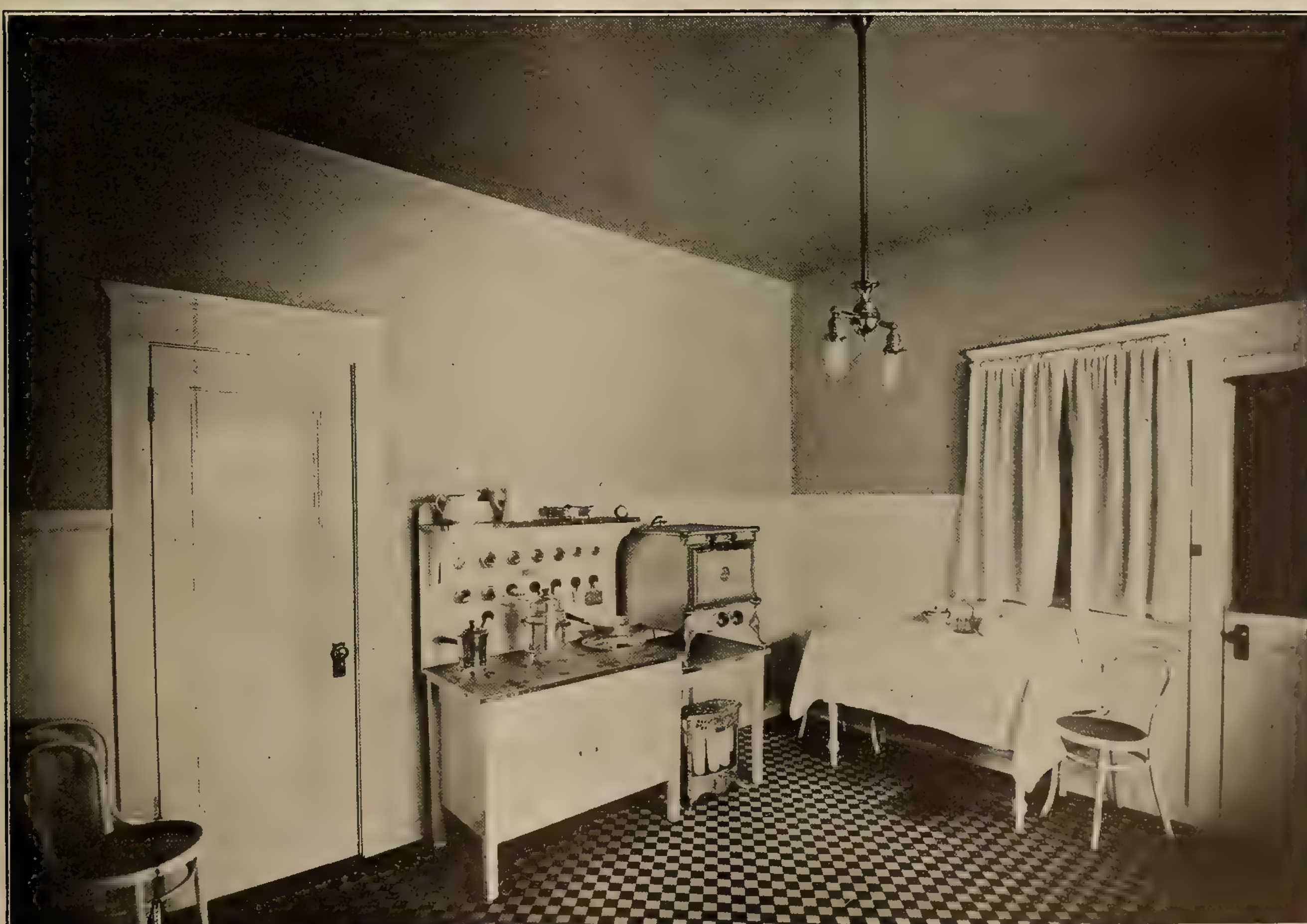


Fig. 1. Trim Appearance of Electric Kitchen at Visalia.

[1]Business Manager Mt. Whitney Power & Electric Company.

rate to compete with other fuels. This was worked up as follows: It was considered desirable to obtain the lighting rate (of 9c per kw.-h.) for the current used for lighting; a reasonable rate for that used for cooking (which appeared to be about 3c per kw.-h.) and a rate for heating about equal to the cost of wood or coal, and yet yield the company reasonable returns. It was expected that 1½c per kw.-h. would answer the purpose. It also seemed advisable to use one meter for each residence, and combine all of the rates by using a sliding schedule, each section to equal the average consumption for its class of service, the one meter method reducing the investment in meters and the cost of handling accounts. A little experience proved the 1½c for heating too high, and January 1, 1912, the following combination residence rate was established:

The first 20 kws. used per month.....	10½c per kw.-h.
The next 150 kws. used per month.....	3½c per kw.-h.
The balance used per month..........	1c per kw.-h.

—with a discount of 15 per cent allowed on all bills paid on or before the tenth of the month. The first two sections covered the average consumption of the residences on the system for lighting and cooking.

The year's experience with this rate has shown it to be very satisfactory. During that period there have been made approximately one hundred installations with a connected load of 700 kws. without a dissatisfied consumer. Every consumer becomes a booster and each outfit sold is a perpetual advertisement for others. Some of the towns are supplied with gas sold at $1.75 per 1,000 cu. ft., while others are dependent entirely upon electricity. With this rate, it is possible to successfully compete with gas, wood, coal or other fuels at the prevailing price, wood being sold at $7.00 to $9.00 per cord, and coal at $16.00 to $20.00 per ton. In almost every installation either a gas, wood or coal range has been displaced, the consumer depending entirely upon electricity in a majority of cases. For heating only, the rate is 3½c per kw.-h., for the first 150 kw.-hrs. and 1c per kw.h. for the balance, with a 15 per cent discount for prompt payment (the liights being registered on a separate meter). This has a tendency to encourage cooking, as the people like to have their lights on the combination rate, in which case they may use all they wish, and after consuming 20 kw.-h., the balance is supplied at the low rate. This also encourages a much more liberal use of light. It was considered inadvisable to supply the complete combination rate to business houses or offices, on account of the wide variation in the lighting demand. To serve that class, the rate of 150 kw.-h. at 3½c and the balance at 1c with the standard discount is used for all heating; a rate of 3½c per kw.-h. with the same discount for cooking in hotels and restaurants, and a flat rate of $8.30 per kw. per month with the standard discount on water or other heaters operating continuously. This flat rate is attractive to restaurants for coffee and hot water urns. About 500 watts continuously seems to be just right for a three-gallon water packeted coffee urn. On combination residence meters, the minimum monthly charge is $2.00, on the other meters, $1.00.

Within the limits of all towns, the company furnishes transformers and runs the service to the building, the consumer paying for the house wiring and the apparatus. In the country the customer furnishes transformers and all secondary lines in addition to the house wiring and apparatus.

The average cooking outfit requires a 5 kw. transformer, while those customers who are doing all of their lighting, cooking and heating will require from 7½ to 15 kw. transformer capacity. In the towns it is possible to operate several outfits from one transformer. The ammeter curves, Fig. 2, gives the load on a 20 kw. 2,200 volt transformer serving four complete cooking and heating outfits, in addition to fifteen houses for lighting only, the total connected load being 95. This curve shows a maximum load of 35 kws. and indicates that when it is possible to bank several outfits on one transformer, the capacity per outfit may be materially reduced, and further, it is safe to operate the transformers under these conditions at considerable overloads, for the reason that the heavy loads are carried only during the winter months, and then are at the maximum when the temperature of the atmosphere is the lowest. The outside temperature rises, the load diminishes.

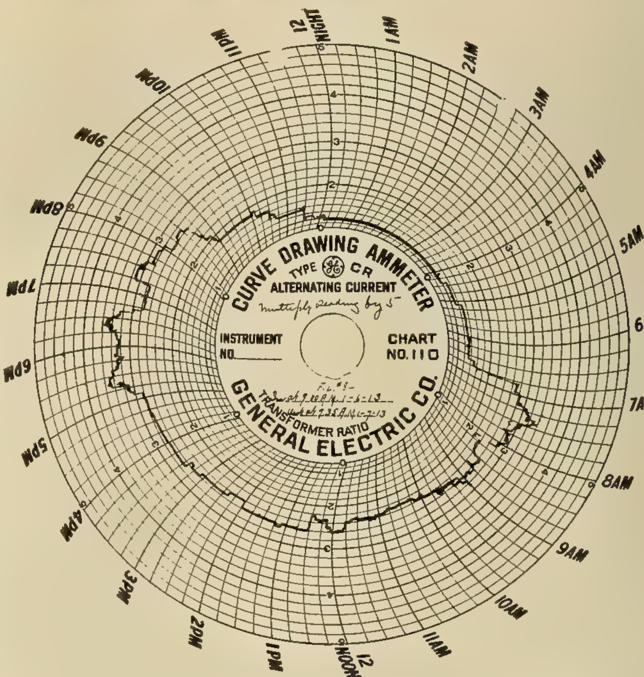


Fig. 2. Typical Ammeter Curve Under Cooking and Heating Load.

For handling the distribution, a 3-wire 110-220 volt, single phase, system has been adopted as standard, though sometimes in the country where a customer has two transformers for operating a pumping plant on the two-phase system, it has been found advisable to draw from both, rather than one, and in such cases, a 3-wire, two phase circuit, is used with a polyphase meter, thus saving the consumer the cost of an extra transformer.

Below are the rules adopted for wiring houses for cooking and heating:

1. Installation of all wires must comply with the requirements of the National Electric Code.

2. A separate circuit with cut-out must be installed for each air and water heater outfit, except when a cut-out is provided to protect each outlet, then one circuit may be used

for several outlets, providing it is of sufficient capacity for the total number all being used at one time, allowing 2½ kw. per outlet.

3. A separate circuit must be installed for each outlet for cooking outfits.

4. The size of wires for cooking outfits must not be smaller than No. 6 B. & S. gauge.

5. The size of wire for heating circuits must not be smaller than No. 10 B. & S. gauge.

6. The potential drop in cooking circuits must not exceed 1 volt between entrance of service to building and the cooking outlet based on 45 ampere load.

7. The potential drop in heating circuits must not exceed 3 volts between distribution cabinet and heater outlet based on 25 ampere load for each outlet.

8. Service lines from main feeders to building must be of sufficient capacity to allow a potential drop not exceeding 2 volts under maximum load on the entire installation.

Nov.	12,	1911—started.			
Dec.	31,	" —2439	kw.-h.	bill	$25.54
Jan.	31,	1912—1798	"	"	20.09
Feb.	22,	" — 877	"	"	12.26
Mar.	25,	" —1585	"	"	18.28
Apr.	27,	" — 931	"	"	12.72
May	25,	" — 402	"	"	8.22
June	26,	" — 227	"	"	6.73
July	24,	" — 140	"	"	5.35
Aug.	28,	" — 221	"	"	6.69
Sept.	26,	" — 323	"	"	7.55
Oct.	28,	" — 543	"	"	9.42
Nov.	27,	" —1127	"	"	14.42
				Total	$147.27 per yr.

or an average of $12.27 per month.

The following is the account of a family of the same size, living in a very similar house, but using electricity for lighting and cooking only:

Fig. 3. Domestic Science School Kitchen Equipped Electrically.

9. All receptacles on heating circuits must have a National Electric Code rating of not less than 20 amperes, except as allowed in paragraph 10.

10. For connecting dining room tables from the floor, a 10-ampere flush receptacle, similar to G. E. Cat. 33441 or Bryant Cat. 1108 will be allowed.

11. When more than one heater is to be used, cooking and heating outfits should be wired for 220-volt 3-wire system from entrance of building to cabinet and to cooking outlet.

12. Where the 3-wire system is used the meter loop must include the three wires.

13. The drop in voltage in a 3-wire system may be 4 volts between the outsides instead of the 2 volts, as in paragraph 8.

14. The drop in 3-wire system may be 2-volt instead of 1-volt, as in paragraph 6.

Below is the account of one of the largest consumers on the system of lighting, heating and cooking, the family consisting of four persons and occasionally five in a house of seven rooms. In this residence, no other fuel was used, though during the summer months, most of the water was heated by a solar heater:

Nov.	23,	1911—started.				
Dec.	30,	" — 90	kw.-h.	bill	$ 3.96	
Jan.	16,	1912— 68	"	"	3.22	
Feb.	14,	" —149	"	"	5.06	
Mar.	16,	" —180	"	"	6.34	
Apr.	24,	" —228	"	"	6.75	
May	18,	" —147	"	"	5.54	
June	18,	" —168	"	"	6.19	
July	18,	" —134	"	"	6.09	
Aug.	19,	" — 12	"	"	2.00	minimum
Sept.	18,	" — 84	"	"	4.34	
Oct.	18,	" —180	"	"	6.34	
Nov.	19,	" ..309	"	"	7.34	
				Total	$ 63.17	per year

or $5.26 per month.

These are fairly representative accounts. Data collected to date indicates that the average residence produces a revenue of about $24.00 per annum for lighting only; about $65.00 for lighting and cooking and about $135.00 when lighting, cooking and heating. The revenue from cooking and heating, including lights, for those residences using the combination rate, amounted to $660.00 for the month of November. This multiplied by twelve will give a fair approxima-

tion of the yearly income from the present load, amounting to about $8,000.

So far, most of the apparatus in use has been manufactured by the General Electric Company, the cooking outfits being what are known as No. 2 White Outfits, and D22 and D40 Ranges. The heaters are of both the tubular and luminous types, the best results in house heating having been obtained by using both types, the luminous to give local heat and cheer, and the tubular to gradually warm the air, making an even temperature throughout the room. Water heating is done with what is known as the G. E. Circulation Type Water Heaters, attached to the regulation house boilers; some being fitted with 2 kw. heating units, which are used intermittently, and others with either 1,000 watt, 750 watt or 500 watt units. Those with the small units are allowed to operate continuously and will always maintain a supply of hot water, providing they and the boilers are of the correct capacity.

The company has given the matter of selecting proper equipment considerable attention, in order that the consumer may be furnished with an outfit suitable to meet the requirements, which is doubtless largely responsible for the success of the venture. The company makes a special effort to look after complaints and make repairs and replacements immediately, so as not to inconvenience the consumer. The manufacturers have stood back of the apparatus in a way entirely satisfactory to every one, and as a result, the cost of maintenance to consumer has been practically nil. To get the business established, and owing to the fact that the company does not have suitable places for displaying apparatus in the various towns, an agreement was made with the leading hardware dealer in each town to handle the goods, the company purchasing, in quantity, and in turn selling to the dealer practically at cost, he reselling it at a small profit. The dealer in each case has erected in front of his store a large electric sign about 3x12 ft., reading, on one side, "Cook With Electricity," and on the other side, "Heat With Electricity." The company supplies free current to operate the signs from dusk until midnight. The dealer is expected at all times to maintain a good window display, and also to exhibit the devices in the store. The company assists the dealers in all possible ways, in making sales, and looks after the apparatus the same as though it was purchased direct. It also sells direct when a person desires to purchase in that way.

The introduction of electric cooking has been the means of cleaning up and materially improving the appearance of many kitchens in this locality. Owing to the cleanliness of the electric method, there has been a marked tendency to refinish the kitchens, painting the woodwork white and tinting the walls light color, putting a light linoleum on the floor and installing a white cooking outfit, the result being that the kitchen, where the lady usually spends a large portion of her time, is one of the most cheerful, attractive and cleanly rooms in the house, for one may cook a meal with the beautiful, bright cooking utensils dressed in good clothes, without fear of soiling the hands or clothes. In fact, many of the kitchens are so attractive, the ladies consider it a pleasure to cook now, as compared with a desire to shun the old dingy, uninviting kitchen, with its black and dirty coal, wood or gas range; and the heating of the house by merely inserting a few plugs or turning a few switches, is so different from the carrying in of wood, building fires, keeping them going, taking up ashes and blacking stoves, that when once one has tried the electric method, nothing short of absolute necessity would induce them to return to the old way.

The new Visalia High School has just completed the installation of a complete electrical equipment in the Domestic Science Department, consisting at present of two ovens, two 3 kw. circulation type water heaters, connected to a 100-gallon tank, and sixteen 8-inch 1500 watt, 3 heat, single disk stoves. Later, it is proposed to add two ovens and six stoves. The walls and ceilings of the room are tinted a light buff, the woodwork is finished in white enamel and the metal fittings are nickel. In the center of the room is a large U-shaped counter, 2 ft. in width, and about 22 ft. in length. On each side around the edge, at the top, is a heavy nickel binding, 2 in. in width. The top of the counter is covered with white tile, laid in cement. On this counter will be placed the nickel-plated, single disk stoves. The ovens are on a shelf along the wall, the top of the shelf being finished in a similar manner to the large counter. The ovens and stoves are all connected to the circuit by means of cords and plugs fitting into 20 ampere Hubbell flush receptacles with nickel plates. On the oven shelf the receptacles are set in the tile near the back edge, while on the large counter, the receptacles are placed on the inside just below the top, the object being to leave the top clear in case it should be desirable to remove the stoves to use it as a lunch counter or for other purposes on special occasions. All the cooking utensils are aluminum, and below each stove in the lower part of the counter is a small closet with a door opening on the outside, where the utensils will be kept. Along the wall on one side of the room is a china closet with glass doors for storing the dishes. In one corner of the room, near the oven shelf, is the cabinet containing the meter cut-outs and switches for the entire installation. The cabinet is finished in white and corresponds with the other woodwork. This room is much the prettiest in the entire building. There has been a tendency on the part of the girls to avoid the Domestic Science course, and the school board, considering that one of the most important studies, decided to make it so attractive the girls would be anxious to take the course.

During the past year the company has erected a new office building, which is entirely heated electrically. There is one large heater constructed of cast grid railway rheostats located in a brick chamber in the basement. The capacity of this heater is 90 kws., it being arranged for three degrees of heat. The chamber is connected to most of the rooms by sheet iron pipes, similar to a hot air furnace. Air is drawn from the outside and forced through the heater into the building by means of a motor driven fan. There is a system of ventilation in the building, consisting of similar pipes connected to a motor driven fan on the roof for exhausting the air. In addition to the main heater, many of the rooms are fitted with indi-

vidual heaters, these being either the G. E. wall bracket tubular type, or the portable luminous. The total connected load of the building is 175 kw.

One of the office buildings in Visalia was recently remodeled and each room wired for electric heat as well as light, there being two separate systems of wiring and places for two meters for each room. In the center is an assembly hall now heated electrically with two 5 kw. tubular air heaters.

The business has now passed the experimental stage and is considered by the people as a reality. Judging from the inquiries received and the interest manifested, it is reasonable to expect that within the next few years electricity for cooking and heating will be quite as universally used in this locality as it is now for lighting and pumping.

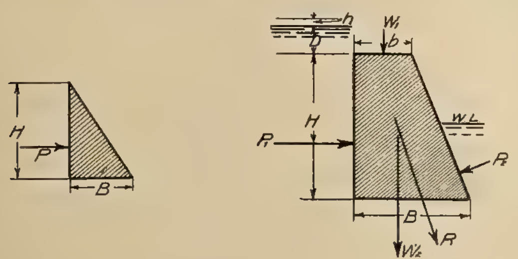
ELECTRICAL PUMPING AND IRRIGATION

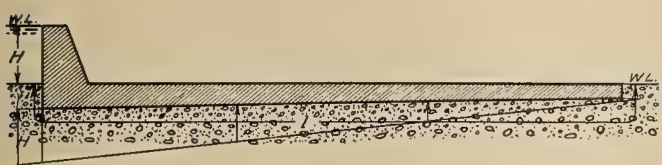
DIVERSION WEIRS.

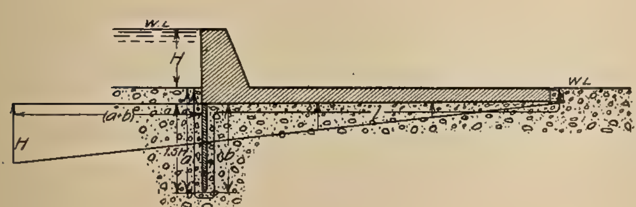
BY B. A. ETCHEVERRY.

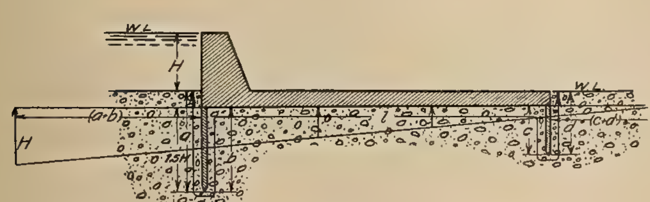
Rollerway downstream face.

The term rollerway is used to designate the downstream face of a weir built on a flat slope, usually 10 to 15 ft. horizontally to 1 vertically. The rollerway is intended to prevent impact and is made rough to decrease the high velocity of the water. This type of construction is largely limited to weirs of the Indian type built on sandy or gravelly stream beds; where the flood flows are large. The principles of design for this form of weir are developed farther.









Theoretical Profile of a Low Dam Not Subject to Overflow.

Theoretical Profile of Overflow Diversion Dam.

Profile of Diversion Weir on Pervious Foundation, Showing Uplift Pressure on Floor With Sheet Piling at Upstream End.

Diversion Weir on Pervious Foundation, Showing Uplift Pressure on Floor With Sheet Piling at Upstream and Downstream End.

Stepped downstream face.

This form of downstream face is intended to break up the impact force by dividing up the total fall into a series of falls, and to decrease the high velocity. To be effective the steps must be made sufficiently long, otherwise the effect will be greately diminished, especially during heavy flood flows. This form is adopted with some forms of crib weirs.

Downstream apron or floor.

This part of a diversion weir is necessary to resist the impact of falling water when there is a direct fall or the high scouring velocity produced by an Ogee fall. When the foundation is impervious hard solid rock the apron or floor may not be necessary, but on softer impervious rock, such as stratified rock, conglomerate rock and shales, a short floor at least is necessary. Where the weir gives a direct fall, the floor length must be at least sufficient for the falling water to strike the floor at its center and preferably two or three times the height of fall. Where the weir forms an Ogee fall at a loose foundation, a total floor length measured from the toe of the Ogee to the downstream end of the floor, equal to two or three times the height of the crest of the weir above the floor is usually sufficient. The thickness of the floor if made of concrete should be not less than 1 ft. and preferably 2 ft. for falls above 20 ft. in height. The concrete floor may be extended with riprap or paving in case of easily eroded stream bed.

When the foundation is pervious material, such as fissured rock, sand, gravel, the apron is an important part of the weir. The length and thickness will depend on the character of the material, the height of the weir, the volume of water passing over the weir, and the upward hydrostatic pressure under the floor. The design of the floor will be considered later in connection with the design of weirs on such foundations.

Water cushion.

The object of a water cushion is to resist the effect of impact and to destroy as much as possible the velocity of the falling water. The depth of water cushion is commonly taken at 1/3 the height of fall. The length of the water cushion must be such that the falling water will strike it midway between the upper and lower edge. The water cushion can be formed by making the basin floor lower than the stream bed by an amount equal to the depth of the cushion or it may be formed above the stream bed by

making the floor at the same level as the stream bed and using a secondary weir or wall, equal in height to the depth of water, for the downstream edge of the basin. The disadvantage of the second method is that it causes a minor fall of water below itself which necessitates the addition of an apron or flooring. The first method is generally used, except for high falls or where the construction of the depressed basin would develop difficulties in construction such as the handling of ground water. With a deep water cushion a thickness of floor equal to 1/10 of the height but not less than 1 ft. is sufficient when the floor is of concrete or reinforced concrete.

Riprap or paving.

On loose foundations of sand, silt, or gravel the water which passes from the smooth apron to the stream bed surface, has a tendency to wash away the material at this end of the floor and form a cavity under the floor which may endanger the structure. To prevent this the floor is continued with a paving or riprap for considerable distance downstream. The length and thickness of this riprap is considered under the design of weir built on pervious foundation.

Impact of ice, trees, etc., on upstream face of weir.

To facilitate the passage of ice, trees and other floating debris the crest of the weir on the upstream side must be curved or built on a slope of 2 to 4 horizontal to 1 vertical.

Form of Masonry Diversion Weir on Impervious Foundation.

A diversion weir differs from a dam proper in that water overflows the crest and the downstream face is subject to the pressure of the backwater. The conditions for stability of a concrete or masonry weir are similar to those of a dam which are:

1. There must be no tension in the masonry.
2. The maximum pressure on any plane must not exceed a prescribed safe limit.
3. There must be no tendency to slide at the joints.

The first condition is met when the section is designed of such width that the line of pressure shall fall at or just within the middle third of the base width. This in almost all cases also fulfills the third condition. For dams not subject to overflow, the theoretical correct outline is obtained as follows:

Let P = total pressure.
H = height of dam.
d = density of concrete.
w = weight of a cu. ft. of water.
B = width of base.
W = weight of section.

$$P = \frac{w H^2}{2}; \quad W = \frac{B H}{2} \times d \times w;$$

If resultant falls at middle third, then:

$$\frac{w H^2}{2} \times \frac{H}{3} = \frac{BH}{2} \times d \times w \times \frac{B}{3};$$

$$H^2 = B^2 \times d; \quad B = \frac{H}{\sqrt{d}}$$

The static forces acting on a diversion weir built on an impervious foundation are: (1) the normal water pressure on the upstream face, (2) the normal water pressure on the downstream face (3) the weight of water on the crest. These pressures must, with the weight of the weir wall give a resultant pressure which will fall within the middle third. These forces are indicated on the accompanying profile.

Where b = width of crest of weir.
B = width of base of weir.
H = width of weir.
D = depth of overflow.
h = head due to velocity of approach.
P_1 = normal water pressure on upstream face.
P_2 = normal water pressure on downstream face.
W_1 = weight of water on crest.
W_2 = weight of weir wall.

The approximate dimensions of the weir wall may be determined by considering it as a simple triangular dam extending to the top of the water surface; its height being equal to H+D+h. The base width is then

$$B = \frac{H + D + h}{\sqrt{d}}$$

The crest width at depth D + h is

$$b = \frac{D + h}{\sqrt{d}}$$

The crest width thus obtained is smaller than is generally used in practice. A formula for top width recommended by Blight is $b = \sqrt{H} + \sqrt{D}$. These dimensions are only approximate and the profile must be checked by computation and modified if necessary. The correct cross section is obtained when the maximum resultant pressure falls within the middle third. The value of the resultant pressure depends on the relative elevations of the water surfaces on the upstream and downstream sides of the weir wall.

The depth of water above the weir crest is determined by the equation $Q = Cld^{3/2}$; where 1 = length of weir crest. The depth of back water or tail water, D_1, depends on the volume of water, the character and grade of the stream bed and is determined by the equation $Q = AC\sqrt{rs}$ where $A = D_1$ and $r = D_1$ (approx.); therefore, $Q = 1D_1 \sqrt{D_1 s}$.

To determine the maximum stress on the dam the resultant pressure must be determined for various stages of the river, by computing for each stage the elevation of the water surface upstream and the corresponding elevation downstream of the tail water, which will give the water pressures on the dam.

Upward pressure due to infiltration or percolation under the weir wall.

Where a weir section is built on fissured rock or on a solid impervious foundation in such a way that the contact between the base of the dam and the foundation is not perfect and allows percolation under the dam, this produces an uplift which must be considered in the design of the cross section. The intensity of this pressure will vary with the distance the water has to percolate and will therefore depend on the total perimeter of contact between the base of the dam and the foundation, including the cut off trenches. The intensity of pressures at the entrance and at the outlet between the two surfaces are equal respectively to the depth of water on the upstream and downstream side of the weir.

Preparation of foundations for weirs built on solid rock not fissured or on material underlaid with impervious stratum at moderate depth.

When on bed rock not fissured shallow trenches are excavated down to impervious rock at the upstream and downstream toe of the weir, these trenches are filled with concrete and form part of the weir, giving a good bond between the weir and the foundation. Where there is danger of infiltration under the weir base a small drain placed under the base near the upper toe and parallel to the line of the upper toe and discharging by means of cross drains 25 to 30 ft. apart are advisable to decrease the hydrostatic upward pressure. To insure a good bond or adhesion between the weir and the rock surface, the rock surface must be cleaned, the cavities filled with concrete and a thin layer of neat cement placed on the rock surface. Anchor bolts may also be necessary. When the diversion weir is a wooden crib or wooden frame weir, the cribs or foundation timbers must be tied to the bed rock by means of drift bolts cemented in the rock.

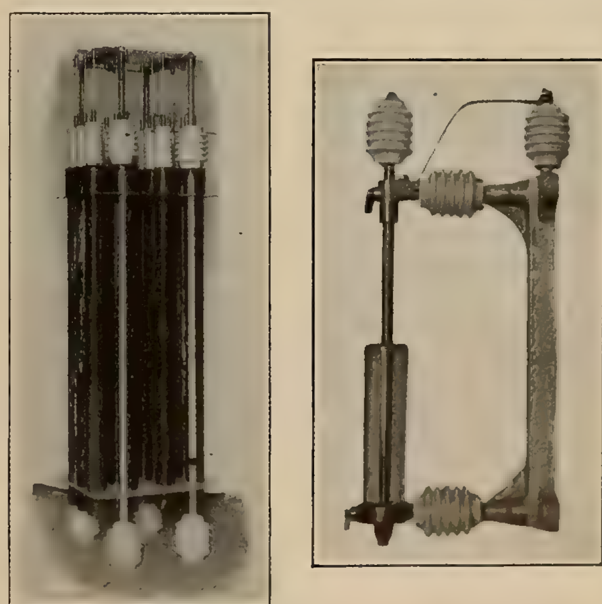
When the weir is built on pervious material underlaid with an impervious stratum at a moderate depth, sheet piling or a cut off wall extending down into the impervious layer must be built at the upstream toe of the weir. A deep cut off wall at the downstream toe or end of the weir floor is not desirable, for its effect is to hold back the water percolating through the upstream cut off wall and thus increase the hydrostatic uplift unless relief openings or drain holes be made in it. The advantage of a downstream cut off wall is that it prevents the washing under the downstream toe of the weir.

LIGHTNING PROTECTION OF TRANSMISSION LINES

CONCLUSIONS ON PROTECTIVE APPARATUS.

BY ALFRED STILL.
Member A. I. E. E., Inst. E. E.

Choke Coils. When a lightning arrester of whatever type is connected between line and ground in or near generating or sub-stations for the purpose of providing a path to ground for high potential or high frequency charges, an inductance is placed in series with the apparatus to be protected. This inductance must not be so great as to cause a serious drop in pressure when carrying the normal line current, neither must it be so small as to allow the induced charges travelling along the line to pass through it rather than jump the air gap of the lightning arrester. This inductance usually takes the form of an air-insulated coil of copper wire or rod, supported at each end on a suitable insulator. The "hour glass" form of coil, in which the diameter of the turns increases from the centre towards both ends, is mechanically stiffer than a cylindrical coil, and any arc that might be started between adjacent turns has a greater tendency to clear itself. The air space between turns is usually from ¼ in. to ⅜ in. Too little attention has been given in the past to the proper design and proportioning of choke coils for use in conjunction with lightning arresters. It has sometimes been argued that, except for the drop of pressure under working conditions and the higher cost, there is no objection to installing very large choke coils having a high inductance. This argument is, however, incorrect, except for the special case in which some protection against surges or resonance effects is provided on the machine side of the inductance in addition to the lightning arresters on the line side. A high inductance may be quite satisfactory if it is merely intended to hold back high frequency currents travelling along the line; but surges may originate near the generators or transformers due to switching operations or other causes, and a very high inductance between the electrical plant and the line will tend to aggravate the effect of comparatively low frequency surges which might otherwise be dissipated in the line, or even through the lightning arrester. In fact, choke coils should be designed with due regard to the apparatus they are intended to protect, with a view to avoiding the building up of high voltages at the terminals of the generating plant in the event of surges being set up in or near the plant itself. When the lightning arrester discharges, it does not follow that high frequency waves do not find their way through the choke coil to the machines; but the inductance of the choke coil will lower the frequency of such waves; or, in other words, will reduce the steepness of the wave front



Mosciki Condenser and Switch.

to such an extent that the insulation of the machines will not be injured. The first few turns of a transformer or generator winding will act as a choke coil and usually prevent damage to the turns farther removed from the terminals; but, as previously mentioned, they are liable themselves to suffer injury, as the charge will leap across the insulation and so get to ground. If it is assumed that the inductance of the first six turns of a transformer winding is suffi-

cient to afford protection to the seventh and subsequent turns of the winding, then a choke coil having an inductance equal to that of the six turns of transformer winding will afford the necessary protection to the transformer. A higher inductance in series is unnecessary and may be dangerous.

The tendency among engineers appears to be towards the use of choke coils of too great inductance. As an example of what appears to be generally sufficient to afford reasonable protection to modern machinery, about 25 turns of copper rod wound into a coil 10 in. in diameter, may be used on voltages from 10,000 to 25,000, while for pressures of the order of 100,000 volts, two such coils would be connected in series. The diameter of the copper rod would depend upon the current to be carried; but it is best to have it large enough in all cases to be self supporting, although coils wound on insulating frames with separating pieces between turns, are not necessarily objectionable.

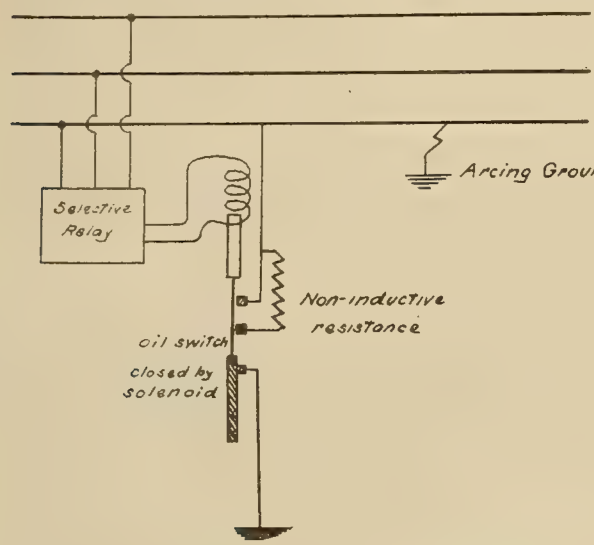


Fig. 7. Diagram of Connections for Arcing Ground Suppressor.

It is probable that copper is generally used for choke coils because the calculation of the inductances at various frequencies is more easily made than in the case of a "magnetic" material, such as iron; but the cost can be reduced by using iron bar or strip in place of copper, and a peculiarity of the iron choke coil is its property of passing currents of normal frequency with comparatively small loss of pressure, while the choking effect with high frequency currents is very much greater.

Arcing Ground Suppresser. If any one conductor of a transmission system is connected to ground through an arc such as might occur over an insulator in the event of a rise of pressure due to any cause, there is the possibility of the arc continuing during an appreciable length of time, sufficient to do serious damage to the insulator, even if it should not totally destroy it. Apart from this danger, every intermittent arc is liable to set up dangerous high frequency surges in the line, especially at the moment when it is finally interrupted. To protect a line against troubles due to this cause, a device known as the arcing ground suppressor, has been introduced. This is an automatic device for momentarily short-circuiting the arc through a switch. By providing a metallic connection between the conductor and ground, the arc is suppressed, and it will usually not re-form when the switch is again opened, because the air in the path of the arc has had time to cool, and the line pressure, which was sufficiently high to maintain the arc once started, is not able to break down the insulation of the new layers of cooler air. The arcing ground suppressor fully described in the Proceedings A. I. E. E. of March 1911[1], but the diagram Fig. 7 will explain the principle of its action. Automatic switches are provided which will connect any one conductor to ground during the very short time necessary to allow the arc to clear itself. The principal feature of the device is the selective relay which will energize the solenoid operating the switch on the faulty line. On high pressure systems, this relay may be of the electrostatic type, generally on the principle of the electrostatic ground indicator. On comparatively low pressure transmissions, the forces would be too low to operate such a device satisfactorily, and recourse is then had to an electromagnetic relay worked through transformers. There are no difficulties or new principles involved in the design of such a relay. When the relay operates, the switch between line and ground is momentarily closed. On re-opening, a suitable resistance is inserted before the final break, to prevent the formation of oscillating currents in the line.

Concluding Remarks. The best means to adopt for the protection of any particular line or portion of a line against lightning disturbances is still largely a matter of conjecture, but by the exercise of sound judgment, an experienced engineer should be able to provide reasonable protection against discontinuity of service during atmospheric disturbances. There are many devices to choose from, each of which has a particular field of usefulness. It is probable that, in a few years time, the additional information on this subject which is continually being accumulated, will lead to uniformity in the protective arrangements adopted under the various conditions arising in practice. In the meanwhile, however, each power system with overhead transmission should keep a careful record of all accidents due to lightning or abnormal pressure rises, as this will generally lead, after careful investigation, to certain amplifications or modifications of the existing protective arrangements such as to prevent the repetition of a similar accident. In this manner, very fair protection can be afforded at the present day to almost any overhead transmission system; but it is doubtful if it will ever be possible to protect apparatus against a direct lightning stroke. Damage to machinery, due to this cause, is, however, very rare.

In regard to the protection of the line itself, it is obvious that protective devices, however complete or perfect they may be, provided at the two ends of a long transmission, afford no protection to the insulators along the line. The frequently grounded guard wire would appear to be a good protection to a line; but here again the engineer must use his judgment, because certain portions of a line may require far more

[1]E. E. F. Creighton—Protection of Electric Transmission Lines; Proc. A. I. E. E, Vol. XXX, p. 377.

protection than other portions, and even if the cost of guard wire protection be considered excessive for the entire length of a long distance transmission, it may yet be a decided advantage to provide guard wire protection near the generating and transforming stations and on those parts of the line most likely to be affected by atmospheric disturbances.

In some cases, it may be wise to improve the insulation and to raise the voltage at which a "spill over" will occur; while under other circumstances it might be better to provide an easy path for a discharge over insulators, by means of suitably disposed arcing rings or equivalent arrangement. Mr. P. H. Thomas once explained the matter of line insulation by making use of a very simple analogy. Where a discharge strikes the line, a wave starts, and the potential of this wave will be such as can be allowed by the line itself; the energy of the discharge is limited by the static capacity of the line and the voltage at which a "spill over" will occur at the insulators. The energy of the travelling waves "grows less and less as they proceed. This action may be likened to the formation of a wave in a long, narrow trough with high sides containing water and normally less than half full, by sudden flooding of the trough by a large quantity of water at some particular point; the excess water spills over and escapes from the trough at the point of the flooding, but there is still a wave started in each direction as high as the sides of the trough will permit; this passes along until the end is reached or the energy of the wave is gradually dissipated. It makes no difference how much water is thrown into the trough, there can be a wave only as high as the sides will permit."

One point that is sometimes overlooked is the effect of the current in the line on pressure disturbances. The disturbances that are set up by switching operations or by power arcs, following a lightning discharge, will be far more serious with a large than with a small power current. This is one reason why extra high tension transmissions suffer less from lightning disturbances than moderate voltage systems on which the current is often larger. It is hardly an exaggeration to say that the handling of heavy currents on long distance transmissions presents more engineering difficulties than insulation problems on the high voltage schemes. Very high voltage transmission lines may, indeed, work satisfactorily without lightning protection, especially when working at pressures near the critical voltage of the corona formation, and some relief to high pressure energy is afforded by the corona itself. Low pressure lines, working at about 10,000 volts, are usually far less exposed than the high pressure lines, and the low pressure lightning arresters are rather more effective than those for the higher voltages. Such lines do not give so much trouble as those working at pressures between 30,000 and 80,000.

It will be gathered from the foregoing remarks that the power transmitted, and not only the pressure of transmission, is an important factor in the problem of lightning protection.

Space does not admit of a detail analysis of the troubles due to switching operations, but, as a general rule, it will be best to energize a dead line of considerable length by first connecting to the line the step down transformers at the distant or receiving end, and then switching the step up transformers at the generating end on to the low tension bus bars.

It is possible that the near future may see some developments in the matter of facilitating the dissipation of high frequency energy in the line itself, with the object of rapidly limiting the amplitude of the travelling waves and the distance from the centre of disturbance at which their effects can be of practical account. It is obvious that what is required is a line that will transmit, without undue loss, the power currents at normal frequency, and yet afford means for the rapid dissipation of high frequency energy. Apart from the property peculiar to the corona, which leads to the dissipation of energy on over-voltages, there is a property common to all metallic circuits which leads to the more rapid dissipation of high frequency than of low frequency energy. The so-called "skin effect" which apparently increases the resistance of a conductor carrying alternating or fluctuating currents, owing to the forcing of the current towards the outside portions of the wire at the higher frequencies, is clearly of value in limiting the distance over which high frequency disturbances are propagated. By covering the conductor with a thin layer of high resistance metal, astonishing results can be obtained. Experiments made with wires having a coating of nickel only 0.07 m.m. thick, showed that the resistance offered to currents of 300,000 cycles per second was four times the resistance offered by the same wires without the coating of high resistance metal. This was referred to by Mr. Gino Campos at the Turin International Electrical Congress of 1911. He, also, by a judicious arrangement of choke coils shunted by non-inductive resistances, showed how a transmission line might be made to offer great resistance to high frequency currents, while currents of normal frequency would be practically unaffected. The choke coil of comparatively low inductance will not interfere with the passage of the power current, but high frequency currents will prefer the shunt path to the choke coil and will be largely dissipated in the resistance.

Devices of this description are of undoubted value, but whether or not practical and commercial considerations will justify their general adoption, is a matter which will probably be decided in the course of the next few years.

CONCENTRATED LOAD GAIN BY NEW YORK EDISON COMPANY.

The New York Edison Company thus speaks of its concentrated power loads: Valuable confirmation is found in our own company records. Take, for instance, a territory devoted to small factories and shops, such as the East Side of New York. Thus, the Delancey district, for the first ten months of 1911, furnished a gain, 129,863 fifty-watt equivalents in connected load. For a similar period in 1912, this gain became 166,785 fifty-watt equivalents. That total includes an increase of ,583 horsepower which speaks for the lower East Side's gain in motor load.

READINESS TO SERVE METHODS

COST OF POWER FOR IRRIGATION.

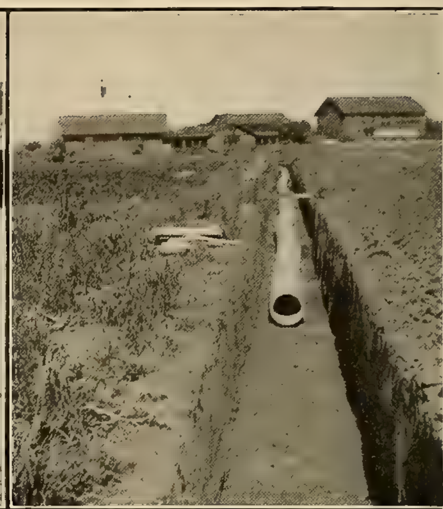
BY ROSS B. MATEER.

When the development of land by irrigation began, the simplest and most inexpensive means were used to divert water from the natural streams. Low lying valley lands, down stream, and the abundance of water supply, afforded endless opportunities for irrigation by ditches at a minimum expense, leaving the uplands, often better adapted for agricultural needs, for later settlers.

The gravity system was the only one considered on account of the low cost of ditch construction, the ease of grading, and the apparently inexhaustible supply of water; yet, as more land was added to that comprising the irrigation district and the demand for water increased, the use of the water was more uniform and continued, and soon the demand exceeded the supply, resulting in disappointment to the user and in the failure of his crops.

The Water Source.

The Reservoir.



The Distribution Line.

A remedy by which the duty of water may be increased or an added supply be made available, was diligently sought, resulting in an investigation of the available supply from natural sources and its utilization for irrigation purposes. Attention was given to the loss of water through evaporation, seepage, and absorption, and the astounding discovery made that in some of the old and established ditches as much as four acre feet of water was admitted through the headgates for each acre foot placed upon the land. In some ditches one-half of all the water passed through the headgates was lost in seepage when traveling a distance of fifteen miles. This loss was further increased when the water was diverted through the laterals and individual ditches. The question arose naturally, "What becomes of the water lost through seepage?"

The Well.

The open well, generally used where the water bearing gravel lies close to the surface, consists of a pit of from ten to fifteen ft. deep, excavated to the gravel bed and walled with concrete block or plank. Wells of this character are usually feasible where an abundant supply of water is found and the lift does not exceed twenty-eight ft. For the elevation of the water a horizontal direct connected centrifugal pump and motor equipment is installed at the bottom of the pit or a vertical centrifugal pump mounted on a framework is placed in the pit and belted to the motor located at the top of the well.

Where more than one water bearing gravel stratum is pierced before an abundant supply of water is developed or where borings of considerable depth are necessary before piercing Nature's reservoirs, perforated casings are sunk through the gravel, permitting of a free flow of water to the suction pipes inside the casings. Pumps, usually of the turbine type are installed where the water level is some distance from the surface of the well and are either direct connected or belted to the electrically operated motor. Wells of this type are usually developed by sucking the fine sand through the perforated casings, leaving the coarse gravel banked against the outside of the casing, providing a strainer and a free passage for the water through the gravel to the suction pipes, resulting in wells of large capacity.

The Power.

The lifting of water by pumps is accomplished by many forms of power, the wind mill, the gasoline or oil-operated engine, the steam engine and the electric motor. Wherever electric current is available the motor is used, supplanting all other forms of power not alone by reason of the simplicity of the motor and its ease of operation, but also its economy. Accurate data compiled by the Department of Agriculture conclusively proves that the electric motor performs twenty-four per cent more work than oil engines of equal rated capacity.

The electric motor requires less care than any

other form of power available for pumping work and always operates when desired and is seldom if ever displaced when once installed.

Each crop requires water at a time peculiar to its own needs. In Colorado only two irrigations are required for grain, the first of six inches about the first of June, the second of four inches thirty days later, a total of ten inches. Sugar beets require from ten to twelve inches of water during the time the crop is filling rapidly below the ground, and principally in August and September. Potatoes require two inches of water when ready to bloom and about ten days later a second run of the same amount; about fifteen days later another two inch run, and the final run about the first of September. Alfalfa demands four inches of water at the cutting of each crop, applied ten days before the cutting, which gives ample time for the soil to be in condition for the machine as well as protecting the roots from exposure to the sun and permitting new shoots to start. Alfalfa properly irrigated will produce per season per acre twelve tons, which at the prevailing market price returns the farmer from $100 to $120 per acre or twenty per cent on land valued at $600 per acre.

Experiments conducted in Wisconsin and compiled in "Irrigation and Drainage," by F. H. King, MacMillan Co., show various yields per acre for the minimum number of acre inches of water:

Table Showing Highest Probable Duty of Water for Different Yields Per Acre of Different Crops.

Least Number of Acre Inches of Water.

Bushels per acre crop.	15	20	30	40	50	60	70	80	100	200	300	400
Wheat.	4.5	6.0	9.0	12.0	15.0	18.0						
Barley.	3,21	4.28	6.42	8.56	10.7	12.84	14.98					
Oats..	2.35	3.13	5.70	6.27	7.84	9.40	10.98	12.54	15.68			
Corn ..	2.52	3.36	5.04	6.72	8.4	10.08	11.75	13.43	16.77			
Potat's		0.41	0.62	0.83	1.03	1.24	1.45	1.65	2.07	4.14	6.2	8.27

Methods of Irrigation.

Water may be pumped and discharged into ditches in which case a pumping plant of sufficient capacity to supply a maximum quantity of water in a short time is installed. Earthen banks properly oiled to prevent seepage may also be erected and become huge storage basins supplying the heavy demands for irrigation and permit of the installation of a smaller pumping equipment.

The first system results in flooding quickly the entire surface of the ground with a thin sheet of water, of which certain quantities are absorbed by the ground at once, the balance flowing to lower levels resulting in an expensive equipment operative only for a short period of time, yet drawing on the wells to such an extent as to materially lower the water level. The second or reservoir system permits of a smaller investment in pumping apparatus and insures water when desired and in such quantities as to equal that obtained with the first system. With a reservoir for storage purposes a smaller unit is installed operating over a longer period of time and earning for the consumer a lower rate per kilowatt hour by reason of a greatly increased load factor. Quoting from tables recently compiled and comparing the two system, it is evident **that twice the number of acres can be irrigated by the use of the reservoir system than when the pump discharges into ditches.** A 6-inch pump, with a capacity of 900 gallons per minute, operating on a maximum head of 50 ft., direct connected to a 20 h.p. motor, will irrigate, pumping direct into ditches, in a period of ten hours, 18 acres to a depth of one inch and where a reservoir 125 x 125 x 8 ft. with a capacity of 1,080,000 gallons is used, double the acreage can be irrigated in the same time, providing the pump is operated over a period of twenty hours.

Reference to the data on capacity of pumps and acres irrigated, as shown in tabulated form, prove conclusively the value of the combined pump and reservoir system.

Irrigation Cost.

What can the farmer afford to expend for irrigation? Obviously it is the difference between two items, the first, the amount paid him for his crop and the second his cost of cultivation, seeding, harvesting, and interest on his investment, such charge to represent a unit cost per acre for each operation incident to cultivation. Figures indicate that for a good yield per acre of sugar beets $17 per acre can be expended for water, with an equal sum for potatoes. The stages of beet cultivation and cost are noted:

Sugar Beets.

Yield—13.4 tons per acre @ $5.50 per ton		$74.25
Expenses:		
Plowing—9 in. deep	$ 2.00	
Preparing seed-bed	1.50	
Planting	.50	
Seed—15 lb. @ 10c per lb.	1.50	
Rolling	.50	
Cultivating	2.50	
Bunching, thinning	7.00	
Hoeing	2.00	
Plowing out beets	3.00	
Topping and piling	9.00	
Siloing 25 per cent of crop	1.70	
Depreciation on farm machinery	1.00	
Hauling—3 miles	8.50	
Interest on investment	16.00	56.70
Available for water		$17.55

The method which can best be used for irrigation is that which insures continuity of flow when desired, and at a minimum of cost. Ditch right or the privilege of tapping an irrigation system will cost $47.20 per acre irrigated (as recently compiled from reports of ditch companies) which at 8 per cent interest on investment, is $3.77, plus $1.68 assessment, bond interest, plus 0.40 maintenance, or $5.85 per season per acre.

The average investment per acre for a pumping plant is $7.25 and computing interest at 8 per cent, depreciation at 3 per cent to which is added the operating expense based on an average lift, maintenance and attendance, a total cost of $2.50 per acre is obtained compared to that of $5.85 for ditch rights.

Other figures based on conditions prevailing in California and where the combined pump and storage reservoir system is used indicate an operating expense of from $2.80 to $3.10 per acre, all of which include the losses by evaporation, seepage and the quantity actually absorbed by the crop. The water pumped from the storage basins, as the water bearing gravels may be termed, possessing advantages such as a uniform temperature, freedom from silt and absence of plant life detrimental to the crops.

LETTER TO EDITOR ON AQUEDUCT DISTRIBUTION PROBLEM.

Sir:—Referring to the editorial headed "Los Angeles Aqueduct Power Problem," in the issue of the Journal of Electricity, Power and Gas, of January 18th, and which I do not believe reflects the attitude of its management, it is very much to be regretted that a paper devoted to furthering the engineering profession and the progress of engineering enterprises in the west should take sides at all in questions of business policy, and it is particularly to be regretted that in taking sides the engineers of the west should be directly addressed through an article of the most biased sort, expressed in the most bitter terms and the substance of which is not founded upon fact, and which, as a whole, is a decidedly false representation of the conditions existing in the city of Los Angeles and the attitude of the city officials referred to.

The question as to whether or not the city's power should be sold to the companies for redistribution or distributed by the city was placed squarely before the people through a straw vote taken in conjunction with a regular election for the amendment of the city charter of two years ago, and the distribution by the city was favored by a vote approximating ten to one. The writer is the only one of the aqueduct engineers who has had occasion to be and has been actively connected with the question of the city's policy in this regard. Practically every one of the city officials, together with the writer, having a full and clear knowledge of the results secured through public regulation of the private companies and the difficulties experienced in accomplishing what has been accomplished, and having a clear understanding of the economic conditions affecting the distribution of the power either by the companies or by the city itself, are convinced that the city and its inhabitants will never realize half the benefits in rates, earnings and service which should be realized by virtue of the city's aqueduct power project, unless the city at this time insists on coming into immediate possession of a distributing system, and either immediately or ultimately into full ownership of such a system on terms and conditions agreed to and fixed at this time. This is due, in part, to the heavy yearly expenditures of the companies in maintaining their organizations as compared, for example, with the corresponding expenses of the city's water department; in part to the profits necessarily allowed the companies; in part to the fact that public regulation is not and probably never will be more than partially effective, and in part to the fact that no city can hope to always maintain in charge of its affairs men who will be wholly loyal to the city in questions affecting private corporations.

These same city officials, together with the writer, have during the several years this question has been considered, constantly maintained that the city should stand ready to purchase the properties of the companies which would be affected by the city's project and utilize the same, rather than install an independent and parallelling system, provided such properties can be purchased at a fair and reasonable price. Such an arrangement could be worked out without depreciating the value of the companies remaining properties, which are devoted to furnishing railway power within and without the city and to the general commercial light and power service outside of the city of Los Angeles. A special committee of the council, assisted by the writer and special attorney W. B. Mathews, has endeavored for several months to make progress toward determining, in conference with the companies' representatives, the exact properties which should be considered and the terms and conditions under which they could be purchased by the city, in an endeavor to work out the question in accordance with the will of the people.

We have been unable, however, to make appreciable progress and it has become necessary, therefore, to place before the people the question of voting bonds for the purchase or installation of a distributing system, the committee still stands ready and is urging that negotiations be continued looking to the purchase of the existing properties. In view of these facts it is apparent that the attitude of certain of the company officials and of the editorial referred to in your journal is no other than an arbitrary declaration to the effect that a municipality does not have the right to distribute electrical energy to its inhabitants under any circumstances.

There is no comparison between the benefits to the city to be derived from the offer of the companies to pay the city .65c per kilowatt hour for power delivered to them in the city at a 50 per cent load factor and the immediate benefits which should and could be derived by the city through the distribution of its own power, even though it should be forced by the attitude of the companies to compete with them. With this question properly determined and without injustice to anyone, unless forced by others than the city officials, it will mean rates 20 per cent lower than the present rates for commercial light and power, with the possibility of further reductions in the future, and will mean the best possible service guaranteed for all time to come.

The editorial speaks of "the chance happening of a rather remarkable series of natural reservoir sites" which, in fact, will result in giving the city a reliable power generating system which will take care of a peak load of 150,000 horsepower, and an average of about 60 per cent of the peak, thus avoiding the necessity of auxiliary steam plants for peak load or other purposes, and claims that this gives the city a great advantage over the companies with which, as the article incorrectly represents, the citys engineers are determined to compete. The fact is that some of the larger power interests investigated Owens Valley before the city's advent, and failed to become interested in it, and it was not until William Mulholland, chief engineer of the city's water department, failing to find an adequate water supply nearer than Owens Valley, made his investigation, and by careful observations and study saw the opportunities which, in the minds of others, did not exist. These opportunities, both as to water and power, have been carefully sought for, with the result that the city has an assured and ample water supply and a proposed power project in conjunction with it which will deliver, when completed, the amount of power stated at a cost of approximately 2 cents per kilowatt-hour.

Instead of making it appear that these opportuni-

ties were a matter of chance it would be more logical to express wonder that, with all the opportunities for reservoirs in the mountains of California where power is being developed, they have not been taken advantage of, as they might have been, in connection with some of the important power projects in the state. The difference lay, not in the question of opportunities, but in the fact that this project was planned by engineers, to meet the needs of a community, unhampered by promoters or financiers.

Trusting and believing that you will give this statement space in your journal, which, I believe, is not only due to the engineers of the west but to the management of the Journal as well, I am

E. F. SCATTERGOOD,
Chief Electrical Engineer.

[The above text appears in this issue in accordance with our invariable practice of publishing all relevant data contributed on all sides of a mooted question, such as this. It should be the function of a technical journal,—and is the purpose of the Journal of Electricity, Power and Gas—to act as a mirror rather than as a molder of public opinion. The editorial in question reflects the attitude not of the Journal's management, but that of an important engineering element,—an element which is frequently denied the privilege of the daily press, but which is at least deserving of a hearing.

The contribution of Mr. Scattergood is welcomed as an authoritative statement illuminating the other side of this question. There may be some who will claim that this communication is as biased, the attitude as bitter, and the foundation of facts as unstable as that alleged in the editorial. But, we all realize that it is only by a consideration of the extremes that the reader is able to form an impartial judgment of the mean.

The editorial contains no "arbitrary declaration to the effect that a municipality does not have the right to distribute electrical energy to its inhabitants under any circumstances," nor was such intended. Every thinking engineer cannot but recognize the inevitable trend toward governmental operation, and the rights of the people to control their public utilities.

While this is undoubtedly a matter of business policy, yet the engineer is becoming daily more and more of a business man as he enters into public affairs, and it is only by the broad consideration and understanding of business matters, that the engineering profession can be advanced.

The frank expression of the opinion published above is appreciated, and we trust will be the incentive to bring forth further discussion of this vital question.—The Editor.]

EXAMINATION FOR ELECTRICAL ASSISTANT

The United States Civil Service Commission has announced a competitive examination for electrical assistant, to be held on February 26th at the usual places. From the register of eligibles appointments will be made at $1080 per annum in the Signal Service, War Department. Applicants should secure Form 1312 from the office of the Commission, Washington, D. C.

INDUCTANCE INTERFERENCE BY HIGH TENSION LINES.

As the result of complaints presented to the Railroad Commission of the State of California by telephone companies of inductive interference by high tension power lines, the commission has authorized the organization of a joint committee which has assumed the title of a research committee. The committee is made up of representatives of the various wire interests in California and representatives of the Railroad Commission, and has undertaken a series of tests to throw new light on the subject. The program of tests to be carried out by this committee is as follows:

Telephone Systems.

1. Complete electrical tests on various types of telephone circuits to determine their electrical and physical conditions when not subjected to power interference.

Power Systems.

1. Complete electrical tests on various types of power systems to determine their electrical and physical characteristics without power in the system.

Combination Tests—Various Types of Telephone and Power Systems Under Normal Operation of Both Systems.

1. Complete electrical tests on various types of telephone circuits under normal operation of power systems.
2. Complete electrical tests on star connected grounded neutral power systems under normal operating conditions.
3. Complete electrical tests on delta connected power system under normal operating conditions.
4. Complete electrical tests on single phase a.c. railroads.
5. Complete electrical tests on direct current railroads.
6. Complete electrical tests on telephone and star connected grounded neutral power systems under conditions of operation other than normal.
7. Complete electrical tests on telephone and delta connected power system under conditions other than normal.
8. Complete electrical tests on telephone and single phase a.c. railroad systems.
9. Complete electrical tests on telephone and direct current railroad systems.

The personnel of the committee undertaking this work is as follows: Representing telephone and telegraph interests, A. H. Griswold, R. W. Gray, C. H. Temple, and L. M. Ellis; representing power interests, H. A. Barre, Louis Elliott, P. M. Downing, and J. E. Woodbridge; representing railroad interests, A. H. Babcock; representing the State Railroad Commission, R. A. Thompson, A. R. Kelly, F. E. Hoar, and J. T. Shaw.

This committee came into existence as the result of numerous conferences between the interested operating companies and the State Railroad Commission, and has evoked widespread interest among the electrical engineering fraternity, both telephone and power as well as telegraph and railroad.

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.
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CONTENTS

Patent Reform

It is questionable if any one will deny the fact that in general the American people enjoy at the present time a scheme of patent protection second to no other country in the world. The fact that a surplus of some six million dollars has accumulated from the administration of the patent department at Washington in contradistinction to continual deficits accruing in other departmental work is indeed a tribute to those having in charge from time to time the carrying on of this great work.

There are, however, grave questions being raised, the country over, as to whether important changes thought necessary should not be incorporated at once. Some of these may be briefly summarized. Many hold that the valuable records of the Patent Office are not completely protected from fire, that their loss would result in endless litigation and that consequent unmeasurable financial loss to the people at large would follow. Such being the case it is urged that sufficient moneys should be made available to prevent a possible disaster of this sort.

Again, the uncertainty of protection felt by the inventor when receiving his patent papers is apparent on all sides. The tying up of patent papers in the routine of patent procedure has done much to aggravate this feeling. The well known Seldon patent is indeed illustrative of possibilities which give substantial footing for such uncertainty. After due notice to all the world, surely, there should be an absolute uncontestable period over which the inventor should be completely protected. Foreign patent methods may well be invoked to throw some light on this important point. It is held under German procedure that the man who discloses the patent is the inventor. After three months of proper advertising, if no contest ensues, the inventor's patent is made incontestable. Strong and public protection is then given him by the government; for anyone infringing is prosecuted by the government itself and upon a finding of willful encroachment the act is made a criminal offense.

Another crucial point over which many take issue is the prohibiting of the fixing of a resale price for a patent. It is true that much good argument may be presented on both sides of this question. The entire subject is worthy of consideration and investigation.

A patent is a contract between the American people and the inventor, whereby in consideration of the inventor making a full disclosure he is supposed to be guaranteed complete protection for seventeen years. The subject of patent reform is, next to the tariff revision, the most weighty now before the American people. Its various ramifications are far reaching, affecting, in one or another way, every household in our country. The American Institute of Electrical Engineers, together with a number of the other learned societies, has passed a resolution urging the most careful and impartial investigation by a properly constituted commission before any remodeling action be taken. The Oldfield bill legislating new patent reform, now before congress, is proceeding without such cautious investigation. To carefully look into and weigh a matter of nation-wide importance is not obstructive but constructive procedure. To be permanent a mat-

ter of such proportions cannot proceed too hastily. A commission representative of the people, the inventor, and the manufacturer, groomed with proper authority, can arrive at constructive ideas.

It is clearly the duty of the western engineer to do everything within his power to urge local chambers of commerce, boards of trade and other civic bodies to take immediate action, looking toward the putting aside of all legislation over patent reform until such constructive information is available from commission investigation.

Choke Coils in High Frequency Phenomena

The Turin International Electrical Congress of 1911 aside from being the official means whereby the International Electrical Congress for 1915 was secured for San Francisco, produced many other matters of scientific interest to the West. It will be recalled that Gino Campos brought about astonishing results in the conductivity of material by covering the conductor with a thin layer of high resistance metal. For instance, wires having a coating of nickel only 0.07 m.m. thick were found to offer a resistance to currents of 300,000 cycles per second four times the resistance offered by the same wires without the coating of high resistance metal. On this principle the same engineer showed that by a judicious arrangement of choke coils shunted by non-inductive resistances a transmission line may be made to offer great resistance to high frequency currents, while currents of normal frequency are practically unaffected.

Even if it may be considered uneconomical to distribute shunted choking coils at intervals along a transmission line, it might yet be well worth while to consider the advantages to be derived from an arrangement of inductance coils shunted by rods of high resistance material on the transmission line side of lightning arresters installed in generating and transforming stations. These would tend to absorb and dissipate some of the high frequency energy before it reaches the arrester, and their use, with or without the addition of condensers to assist in flattening out the wave front of high frequency oscillations, might, under certain conditions of operation, prove decidedly beneficial. Such auxiliary apparatus must, however, be proportioned on scientific lines, or there is the danger of aggravating the original trouble through reflection of the high frequency waves.

Filling Out the Winter Valley

It is an unusual phenomenon to find a power company with a winter load less than the summer requirements. Such, however, is the state of affairs to be read from the chart records of the Mt. Whitney Power and Electric Company. The circuits of this company cover a fertile agricultural district situated in the upper San Joaquin Valley of California. Citrus and deciduous fruits, together with alfalfa, grow in abundance in this locality when properly irrigated. Pumping water has consequently developed in such proportions that the company now finds its summer demands for power greater than for the long evenings of winter. When it became apparent that such was the case, Western business ingenuity at once set to work to devise some scheme whereby inequality of load conditions might be adjusted. It is interesting to detail the method of procedure.

As wood has in this particular section of California a market value of $7 to $9 per cord, coal $16 to $20 per ton, and oil gas $1.75 per 1000 cu. ft., it became manifest at once that electric heating could be made a strong competitor. A graduated scale was at once put into effect whereby, although the first 20 kw.-hrs. used per month would cost the consumer 10½ cents per kw.-hr., the next 150 kw.-hrs. could be purchased on the basis of 3½ cents per kw.-hr., and above this a rate of but 1 cent per kw.-hr. was instituted. A fifteen per cent discount is also granted in addition, if bills are paid before the tenth of the month.

On account of the wide variation of lighting demanded in the business district, a slightly different rate is instituted. The rate for all heating is here made for 150 kw.-hrs. at 3½ cents and the balance at 1 cent with the standard discount; a rate of 3½ cents per kw.-hr., with the same discount, for cooking in hotels and restaurants, and a flat rate of $8.30 per kw. per month with the standard discount on water or other heaters operating continuously.

Such inducements as these have had a most marked effect on the community served. The consumer immediately becomes a booster. The flat rate is especially attractive to restaurants for coffee and hot water urns. The housewife, too, finds domestic troubles vastly simplified. The cleanliness of electrical appliances has led to aesthetical development in the kitchen hitherto unattempted. Indeed, so wholesome is the demand for electrical cooking, the department of domestic science in the Visalia high school has found it to advantage to install complete equipment for the instruction of girl students in the art of cooking.

While in many other districts of the West conditions are not always so favorable for a campaign of this sort, due to cheaper available supply of fuel, still the lesson is a forceful one, and Western power managers would do well to carefully study such possibilities in their own particular fields of activity.

The past decade bears witness to the fact that fortune indeed loves a bold wooer. The gigantic returns that have followed the construction of electric interurban networks is but one instance. Here now at Visalia is an instance of constructive managerial policy which must surely bear fruit on the morrow. A policy that even invades the schools to educate the future wives of a community in the art of cooking by electricity is laid along the broadest lines. With the hotels and restaurants operating by electric service for heating, lighting and electricity, and with the private houses using every possible electrical appliance along scientific lines attained under proper instruction in the high school domestic science courses, it would seem that the valley load of the power company must perforce automatically flatten out and, in the community served, domestic science must be to the housewife a joy forever.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. A. Lardner of J. G. White & Company, has just returned from a visit to Los Angeles.

A. P. Davis, engineer in the United States Reclamation Service, is visiting San Francisco for a few days.

Fred F. Small, electrical engineer of the Pacific Electric Railway Company of Los Angeles, is in the East.

H. V. Carter, president of the Pacific States Electric Company, left this week for a visit through the northwest.

Lee de Forest, research engineer of the Federal Wireless Telegraph Company, has returned to Palo Alto, Cal., from the East.

John Coffee Hays of the Mt. Whitney Power & Electric Corporation at Visalia, Cal., is spending the week in San Francisco.

J. C. Barber, president of the City Light & Power Company of Ketchikan, Alaska, is spending several weeks in California.

F. H. Leggett, Pacific Coast manager of the Western Electric Company, has returned to San Francisco after a week's visit to the Seattle office.

H. T. Blosser, Northwest representative of the Holophane Works of the General Electric Company, has returned to Portland, Ore., from a visit to California.

A. H. Nicoll has resigned from the employ of the Western Electric Company to take up his new work with the Utah Power & Light Company at Salt Lake City.

A. J. Turner has recently severed his connection with the industrial department of the Great Western Power Company to undertake similar work for the Oro Electric Corporation of San Francisco.

Frank F. Fowle announces that he has severed his connection with the McGraw Publishing Company as one of the editors of Electrical World, and will resume his electrical engineering practice with offices at 68 Maiden Lane, New York City.

Frank E. Watts, eleventh Jupiter of the Jovian Order, is being entertained by the several Pacific Coast organizations, having been at Spokane, Seattle and Portland during the past week and planning to be at San Francisco and Los Angeles during the week to come.

D. C. Greene, manager of the Oregon Power Company at Marshfield, Oregon, has returned from Washington, D. C., where, as president of the Marshfield Chamber of Commerce, he was successful in securing an additional appropriation for the improvement of Coos Bay harbor.

Charles H. Lee has opened offices as hydraulic engineer in the Union Oil Building, Los Angeles, and will make a specialty of water supply problems, particularly those of underground waters. For several years Mr. Small was assistant engineer on the Los Angeles Aqueduct, in charge of the extensive water supply investigations in Owens Valley, which included an intensive study of underground water conditions in co-operation with the water resources branch of the United States Geological Survey. More recently he has carried on underground water investigations in several of the central and southern California valleys for the State Conservation Commission and various water companies, and, as hydraulic engineer for the Cuyamaca Water Company of San Diego, appeared before the California State Railroad Commission during the recent rate fixing case.

N. C. Kingsbury of New York, vice-president of the American Telephone & Telegraph Company, and in charge of the long distance and publicity department; **Angus S. Hibbard** of New York, vice-president of the same company and adviser to the executive department; **Edw. H. Fields Jr.** of Denver, vice-president of the Mountain States Telephone Company; **E. H. Moulton** of Minneapolis, president of the Tri-State Telephone Company of Minnesota, and **T. S. Lane**, president of the Home Telephone Company of Spokane, were in conference in San Francisco during the past week regarding governmental regulation of telephone companies. All of the officials agree that the regulation by the commerce commission is much to be preferred to the compulsory competitive provisions of the Sherman anti-trust law. They also regard favorably the attorney-general's statement to the commission that state regulation cannot be a satisfactory method of ultimate solution of the questions arising out of telephone operation, and that the value of a telephone service depends largely upon the facility of connecting every individual telephone user with any point upon any telephone line in the United States.

MEETING NOTICES.

Los Angeles Section A. I. E. E.

A regular meeting of the Los Angeles Section of the American Institute of Electrical Engineers was held at the Hotel Hollenbeck, January 28. Ralph Bennett presented a paper on "The Planning of Industrial Cities With Special Reference to Public Utilities." The paper was illustrated with lantern slides and in a general way covered the layout of streets and railroad rights of way, also the location of the business and residence section with reference to industrial plants and the location of other utilities throughout the property.

San Francisco Jovian Club.

The regular weekly luncheon of the San Francisco Jovian Club was held at Tait's Cafe on January 28th with a large attendance. Final discussion was held on the plans for entertaining the reigning Jupiter, Frank E. Watts, upon his arrival at San Francisco, and on the rejuvenation to be held in Oakland on February 5th. The membership committee reported that seventy-five applications had been obtained with good prospects for raising the number to one hundred within the next week. Favorable action was taken on the invitation of the Electrical Development League that the two organizations affiliate, and a committee was appointed to confer with one from the Electrical Development League with regard to the necessary revision of the by-laws of the organizations. R. M. Alvord presided.

Oregon Technical Club.

The regular luncheon of the Oregon Technical Club was held Tuesday noon, with Mr. H. G. Beckwith of the Portland Architectural Club as chairman. Mr. Gay Lombard spoke on "Home Industries" in Portland and Oregon. He even extended this idea of fostering "home industries" to cover the designing of the Oregon Building at the Panama-Pacific International Exposition, and a resolution was adopted urging that the selection of an Oregon architect for the Oregon Building be determined by competitive methods.

Portland N. E. L. A.

The next regular meeting of the Portland Branch of the National Electric Lamp Association will be held Tuesday evening, February 4, at 8 o'clock, in the Assembly Hall of the Electric Building. A paper will be presented by Mr. H. E. Plank, steam turbine engineer of the General Electric Company on "Design and Application of Steam Turbines." The meeting will be presided over by A. S. Moody, local supply manager, General Electric Company, Portland, Oregon.

SAN FRANCISCO SECTION, A. I. E. E., BANQUET.

The San Francisco Section of the American Institute of Electrical Engineers held a banquet and entertainment at the Poodle dog restaurant on Saturday evening, January 25th, in honor of President Ralph D. Mershon. There was a large and enthusiastic attendance, there being nearly 150 engineers around the board. Students from the Stanford University and from the University of California provided several unique entertainment features; Joe Thompson also contributing his quota. H. W. Crozier, chairman of the local section presided through the larger part of the evening, but after the black coffee was served he turned the meeting over to W. W Briggs, who introduced the principal speaker of the evening, President Ralph D. Mershon, in a most happy manner.

Banquet of S. F. Section A. I. E. E., in Honor of President Ralph D. Mershon.

President Mershon congratulated the section on the high load factor indicated by the large attendance, particularly from the nearby student branches. In this connection he spoke of the reception recently accorded him at Cornell University and of the opportunity for good that resides in the student branch. Especial attention was called to the midwinter Institute meeting at New York under the auspices of the Standard's Committee, and the series of lectures on "Radioacticity" by Professor E. T. Adams, during the last three weeks of May.

The policy of the present administration is to broaden the work of the Institute so that its papers may represent the results of experimental investigation and that the lectures present information on a wide range of associated topics. Foremost of these, in the opinion of the speaker, is that of economics. An engineer who is not an economist is not an engineer. Depreciation, going value, and such topics have as much to do with electrical engineering as has education.

The local sections are being urged to see that individual members take an active interest in civic matters. An engineer is better fitted by training and reasoning ability than any other class of men to solve civic problems.

A. W. Thompson gave a most humorous rendition of George Ade's views of the scholar and the dollar, which required all of the ability of Professor H. J. Ryan to refute. Brief talks were also given by H. P. Gillette and A. H. Babcock. An exhibition of moving pictures on electrical and engineering subjects concluded the evening's entertainment.

Portland Jovian Electrical League.

Fifty-four members of the Jovian Electrical League met at the Hazelwood January 16, 1913. While lunch was being served, Mr. Barker of the General Electric Company was chosen treasurer, Mr. Moody retiring, after serving since the club was organized last spring. H. S. Wells, new business manager of the Pacific Power and Light Company, was introduced by the chairman, Mr. Barnett Goodwin of the Northwestern Electric Company, and gave a splendid talk on modern irrigation by means of electric power, and what the Pacific Power and Light Company was doing in that field in the Yakima, Walla Walla and Columbia River valleys. He stated that 112 plants were installed during 1911 and 173 during 1912, consuming approximately 2300 h.p. By the use of arc lamps, it was possible to stimulate the growth of several kinds of vegetables, making it possible to market them from ten to fifteen days sooner. He also stated that chickens could be fattened by the same process; that is, turning on the light at feeding time and turning it off right after, making Mr. Chicken think it is bed time, to sleep, eat and grow fat. Mr. Wells closed by saying that electricity has solved the problem of irrigating all the land, the top land as well as the bottom, making the farmer realize a net return on his whole farm. Electric power is also used in the farmer's home for light, heat and power, making it possible to enjoy all the comforts of a modern home.

TRADE NOTES.

The Great Western Power Company, San Francisco, Cal., will install in its station two large 12,500 k.v.a. generators, one 500 kw. exciter and switchboard apparatus. These units are being built by the General Electric Company.

The annual sales convention of the Pacific Coast salesmen of the H. W. Johns-Manville Company will be held at the Palace Hotel, San Francisco, the week of February 3-9, inclusive. This convention will include all of the managers and selling forces of the Pacific Coast branches from Vancouver, B. C., to El Paso, Texas. There will be a general head office and factory representatives present to address the convention, among the latter including the following New York men, each being general manager of department named: H. R. Wardell, roofing department; J. A. Stone, cold storage and insulating department; L. R. Hoff, asbestos and magnesia department; S. G. Meek, electrical department; B. C. McClure, packing department; R. S. Massa, ice machine and refrigerator department; C. M. Swan, acoustical department; as well as W. H. Lawrence, waterproofing department, Chicago. These gentlemen have been selected as being capable of giving especially valuable information on the products of the company in their respective departments.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

OUTSIDE WIRING AT SEATTLE.

BY J. J. WETTRICK.

(Concluded.)

Section 11 makes it unlawful for any person other than the owner or his representative or the proper official or employe of the city to interfere with or molest any wire.

Section 12 in this ordinance says that no provision in this ordinance except the one relating to wires more than 13 in. from center of pole, shall apply to any person operating an electric street railway system in so far as it effects direct current wires used in connection therewith.

Section 13 gives all companies three years in which to comply with this ordinance. This was passed March 7, 1911, so that by the 7th of March, 1914, all the construction in the city should be made to conform with this ordinance. Section 14 provides a penalty of a fine of not less than $10 or more than $500, or imprisonment of not more than six months. These are practically the main features of the ordinance. There are a great many things not covered in this ordinance and I might say in this connection that prior to the time this ordinance went into effect there were practically no rules in force governing wiring on poles except such as the companies themselves had adopted and the few rules promulgated by the department of public utilities. When the public utilities department was created we began to formulate some rules. We put these into force and effect by having them passed upon by the board of public works. And about the only provision of the franchise through which we could enforce them, is the provision in nearly every franchise that all construction work done thereunder shall be done under the supervision of the board of public works. So we formulated some rules and secured the approval of the board of public works and in that way put them into force and when this ordinance was passed it embodied some of those rules, but not all, so we revised them and adopted a new set of rules which are supplementary to this ordinance, the main provisions of which I will state: * * * * *

I wish to take this opportunity to briefly tell you of the functions and work of the department of public utilities. I find that a great many people do not know what is the province of this department of the city government. The city charter in prescribing the duties of the superintendent of public utiltities says that he shall rigidly enforce all the provisions of the various franchises and to superintend all franchise construction work and keep accurate records thereof. As to enforcing the provisions of the franchises, that is only a small part of the work because the franchises, especially the earlier or older franchises are very deficient in provisions giving the city any power of supervision over them but they nearly all contain the provision that construction shall be done under the supervision of the board of public works, but we find that we have to ask for concessions from the companies, things which should be in the franchises but for various reasons were not put in there and we get a great many of these concessions from all the companies, for instance from the Puget Sound Traction, Light & Power Company, have agreed to remove all of the wooden span wire poles from the business district. There are two ways of doing this. One way is where buildings are of the proper construction or type we in the department, secure from the owners of these buildings permits to attach eye bolts to which to attach span wires which in turn carry trolley wires and wherever we secure these permits we turn them over to the traction company and they put in these eye bolts and take out the wooden poles. Where we can't secure eyebolt permits due to the fact that there is no building or that the building will not stand the strain of a span wire, they take out the wooden poles and put in iron poles 25 ft. tall and 7 or 8 in. in diameter at the bottom and about 5 in. at the top. While they are not very desirable to have in the street, they are far less objectionable than the old wooden poles. In that way, you will notice we have already eliminated all wooden poles on First, Second, Third and Fourth avenues between Yesler Way and Pine street. We are now working below Yesler Way in the wholesale district and expect within four or five months to have most of these poles down, except those that still have city light department wires on them.

In line with these wiring ordinances, I might mention a wiring ordinance that went into effect three years ago providing that within a certain district, the limits of which were: on the South Jackson street, on the North Cedar street, on the West First avenue and Post street and on the East Fourth and Fifth avenues all wires must be placed underground within three years. That time expired on the 12th of last September. The electric company spent upwards of one-half a million dollars to comply with this ordinance and now, with one or two exceptions, have all of their wires underground and so have the telephone company and the different messenger companies. This ordinance also provided a penalty of about $100 per day for each day after September 12, 1912, until all wires are placed underground. but this penalty has not been enforced.

In addition to the above we supervise the construction of all railroad and street railway work, underground work of all kinds, such as telephone, electric light and power conduit installation, gas and steam mains, etc. We also formulate standard plans for this construction. However, in the downtown streets in the older portion of the city, we have not been able to enforce these for the reason that so much stuff was already in the streets and put in in a promiscuous manner. We have some drawings showing existing conditions in the older portion of the city where everything is mixed up and put in in a haphazard manner and there is a wonderful mixup in some of these streets. However, there are some twenty miles of streets in the city which we expect will be business streets within the near future, that during regrade operations were either filled so much that existing stuff became useless or were cut down so much that all the stuff was taken out. In these streets we have a clear field and for these streets we have standard plans and we have a place for everything and aim to get everything in its place and in that way we can not only cheapen the construction for the different companies but we can get more into the streets. There is a great traffic below the pavement of the street, more so than a person not familiar with it would ever imagine. Take First and Second avenues, you could probably not once in fifty times dig a hole 2 ft. square without striking something.

Then we also formulated standard plans for street railway construction, track laying, planking, etc., also for steam railroads. We keep an accurate record of everything that is in the streets. I might say that in the downtown streets where we did not have a show to put our plans into effect, we now have a record of nearly everything in the streets and the way we got this was by simply keeping our eyes pealed and whenever we saw a hole dug in the street or pavement we would go there and take notes on everything that showed up in that hole and in that way in a series of holes on up the street, we were able to plat the thing so that we know pretty nearly where everything is and I think we have a record of pretty nearly everything.

I wish to amplify somewhat a statement which I made in reference to cheapening underground construction as well as surface and overhead work by our inspection and standard plans. It may not appear at first just where the benefit to the people is in this. It comes about in this way, when the rate making power is vested in a public body, as in this state, "The State Public Service Commission" and we can save the public service companies any money, it

will eventually revert back to the people in the form of low rates. For instance, sometime ago the Independent Telephone Company requested the State Public Service Commission to increase the company's rates and the way they determined the justice of the matter was to determine the cost of the plant and the cost of the operation and thereby arrived at the proper rate to be charged to insure a reasonable return on the investment and consequently allowed them to increase their rates very materially. Now, if we can in any way keep the cost of these plants down we thereby give them less chance to increase their rates by a showing on their investment.

PROPOSED ELECTRICAL LICENSE BILL BEFORE CALIFORNIA LEGISLATURE.

Regulating the Licensing of Persons Engaged in the Business of Installing any Wires or Electrical Apparatus to Convey Electric Current for Light, Heat and Power, and to Provide for a Board of Electrical Examiners for Said Purpose, and to Prevent the Doing of Such Electrical Work by Persons Other Than Those Licensed in Accordance With the Provisions of This Act, and to Provide a Penalty for the Violation Thereof.

The people of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1.—It shall be unlawful for any person to engage in the business of installing electric wires, conductors and apparatus to be used for the transmission of electric current, for electric light, heat and power purposes, and to do the business of a "master electrician" as defined in Section 5 of this Act, unless said person shall have obtained a license from the board of electrical examiners, duly authorized and appointed under the provisions of this Act to issue licenses.

Sec. 2. Within thirty (30) days after the enactment of this Act, the Governor shall appoint a state board of electrical Examiners, consisting of five members, two to serve for one year, two for two years, and one to serve for three years, who shall be persons skilled in the installation of electric wires, conduits and apparatus for the transmission of electric current, for electric light, heat and power purposes and all of whom shall be residents of the State of California, and all of whom shall have been engaged in the business of "master electrician" as defined in Section 5 of this Act for a period of five years, next preceding the dates of their respective appointments.

The governor shall have power to remove any member of the commission for incompetency or improper conduct on satisfactory evidence thereof being presented, and he shall fill by appointment vacancies occurring in said commission.

Sec. 3. The members of said Board before entering upon their duties, shall respectively take and subscribe the oath of office required of other state officers, and they shall have power from their number to elect a president, and a secretary, who shall be ex-officio treasurer of said board, and after their appointment and qualification, said board shall organize by the election of the officers herein set out.

Said board shall have the power to adopt such rules and by-laws for the transaction of the business of the board, and the management of its affairs, as they may deem expedient, and shall adopt a seal for the attesting of such licenses, as are necessary in carrying out the purposes and provisions of this Act.

The president and secretary shall have the power to administer oaths, and the board shall meet not less than four times in each year at the City of Sacramento, and at such other times and places as the business may require, and three members of the board shall constitute a quorum for the transaction of business.

Sec. 4. The board shall keep a record of its proceedings and a register of all applicants for examination and licenses, and all licenses and renewals of the same issued by said board shall bear the seal of said board together with the signature of the president and secertary thereor.

Sec. 5. The term "master electrician" as used in this Act, shall be so defined as to include any and all persons engaged in the business of, or holding themselves out to the public as engaged in the business of installing, erecting or repairing or contracting to install, erect or repair electric wires or conductors to be used in the transmission of electric current for light, heat or power purposes, or moldings, ducts, raceways or conduits together with fittings for same, for the reception or protection of such wires or conductors or to electrically connect electric wires or conductors together, or to any electrical machinery, apparatus, pipes or fixtures to be used for electric light, heat or power purposes.

A license of "master electrician" issued or granted under or in accordance with the provisions of this Act shall entitle any person to engage in the business of installing, erecting or repairing or superintending the installation, erection or repairing of any electrical wires or conductors to be used for the transmission of electric current for electric light, heat or power purposes, and any moldings, ducts, race-ways and conduits together with fittings for same, to be used for the reception and protection of said wires and conductors, and to electrically connect such electric wires or conductors together and to any apparatus, pipes, fittings or fixtures to be used for electric light, heat or power purposes.

Sec. 6. Before any person shall hereafter engage in the business of "master electrician" as defined in section 5 of this Act, and before any person now so engaged in said business, or any branch or class thereof shall continue in said business of "master electrician" such person shall apply to said board for a license to practice as "master electrician" and the applicant shall present himself before said Board at a time and place fixed by said board, of which the applicant shall receive at least ten (10) days' written notice. If the board shall find upon due examination that the applicant presenting himself is of good moral character, has a satisfactory knowledge of electricity, and the natural laws appertaining to and governing the same, and of the use and function of electric wires, appliances and devices for electric light, heat and power purposes, and is possessed of skill, experience and knowledge in all matters appertaining to the business of "master electrician" as defined in Section 5 of this Act, the said board upon payment of the fee hereinafter provided for, shall issue to the said person a license as "master electrician" to practice said business for a term of one year, and shall register such person as duly licensed "master electrician." Provided, that any person at the time of the enactment of this Act who is actually in the business of "master electrician" as defined in Section 5 of this Act, and who shall within six months after the taking effect of this Act, file with the board of examiners, application and an affidavit setting forth his name, residence, length of time during which he has been engaged in said business of "master electrician," and the place where he has practiced the said business, shall be entitled without examination to a certificate as "master electrician" upon the payment of the license fee hereinafter provided, if it shall appear from said affidavit, in addition to the other facts therein set forth that said person has been actually engaged in the said business of "master electrician" as defined in Section 5 of this Act for a period of three years next preceding the date of the filing of said affidavit.

Sec. 7. No person shall engage in the business of "master electrician" as defined in Section 5 of this Act after six months from the date of the taking effect of this Act without holding a license from said board. Any person wilfully engaging in said business of "master electrician" as defined in Section 5 of this Act without holding such license as herein provided for, shall be guilty of a misdemeanor, and upon conviction thereof, shall be punishable with a fine of not less than Twenty-five (25) Dollars, or more than One Hundred

(100) Dollars, or by imprisonment for not less than five (5) days or more than sixty (60) days in the county jail, or by both such fine and imprisonment.

Sec. 8. Each applicant at the time of the filing his application shall pay to the secretary of said board of electrical examiners the sum of Twenty-five (25) Dollars, which sum in case the affidavit of the applicant or the examination is satisfactory, as the case may be and the license granted to the applicant, shall be placed to the credit of the board with the treasurer thereof.

In case said application shall not prove satisfactory, then and in that case, said fee shall be returned to the applicant, and memorandum thereof made on the records of the board, provided, that in case any applicant shall not pass a successful examination, and be granted his license as herein provided, then said applicant shall not be permitted to make another application, and to submit to another examination, by said electrical board until a period of six months has elapsed after the denial of his application for a license, and provided, further, that if there shall be on file at any time with the secretary of said board of electrical examiners, applications from persons resident in any incorporated city, city and county or township, to the number of twenty-five (25), the board of electrical examiners shall proceed at once to hold an examination in said incorporated city, city and county or township of said applicants.

Sec. 9. All licenses issued by said board shall be renewed without further examination upon their expiration, on the payment of the sum of $10.00 for each license so renewed. All licenses shall be for the term of one year, and all licenses renewed shall be for the term of one year from the date of such renewal. Said board shall have full power to revoke for proper cause any license or renewal of same after a full hearing of all parties in interest.

Sec. 10. Nothing in this Act shall be construed to prevent any person, firm or corporation from doing or performing any work necessary to the installation of electric wires, conduits and electric apparatus, or for doing any of the work defined in Section 5 of this Act, or from entering into any contract for the doing of such work, provided, that said work is performed under the direction and supervision of a duly licensed "master electrician" as provided herein.

Sec. 11. No license or renewal of the same granted or issued under the provisions of this Act shall be assignable or transferable.

Sec. 12. All license fees collected under the provisions of this Act shall be for the use of said board to defray its expenses, and out of the funds, coming into the possession of the board, each member of said board shall receive as compensation Ten (10) Dollars for each day actually spent in attendance to the duties of his office, and mileage at the rate of five (5) cents per mile for all distance actually traveled in going to and from the meetings of the board.

The secretary of said board shall receive such compensation as secretary and treasurer of the board as the board may deem just and reasonable for his services, and the said secretary as treasurer, shall give a bond to the State of California in the sum of Ten Thousand (10,000) Dollars with sureties approved by the board for the faithful discharge of his duties both as secretary and as treasurer.

Said expenses shall be paid from the fees received by the board under the provisions of this Act, and no part of the salary or other expenses of the board shall ever be paid out of or become a charge upon the state treasury.

It shall be the duty of the said board before the first Monday in January of each year to make a report in writing to the governor of the state, containing a detailed statement of the receipts, manner of expenditure, and any balance of money remaining at the end of the year after the payment of the expenses, and the per diem of the members of the board, shall remain in the treasury of the board to meet the expenses of the ensuing year.

Sec. 13. All Acts and parts of Acts inconsistent with the provisions of this Act are hereby repealed. This Act shall take effect immediately.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

January 9.

The Tujunga Water & Power Company, a Southern California corporation, filed a motion with the Commission asking for the dismissal of its application previously made for an order to issue bonds. The company based its motion on the ground that it is not a public utility and not subject to the jurisdiction of the Railroad Commission.

The Commission received and approved an opinion from its attorney to the effect that the Commission has no jurisdiction over the matter of safety appliances on ferry boats navigating the waters of this State, and that this jurisdiction is vested in the Federal Government.

The Imperial Valley Gas Company was granted authority to issue $154,500 of bonds for the extension of its system to cities in the Imperial Valley and otherwise enlarging its plant. The Commission provided in its order that the company should pay no dividends until it had set aside $10,000 from profits and invested it in its plant.

January 11.

A decision was rendered granting the application of the Western States Gas & Electric Company to issue $397,000 of bonds.

January 13.

The Great Western Power Company applied for authority to issue first mortgage 5 per cent forty-year gold bonds to an amount sufficient to yield $3,971,731. The proceeds will be devoted to the completion of Big Meadows dam and reservoir, to the purchase of additions to property, and new construction and equipment.

The Elsinore Electric Light & Power Company and the Southern Sierras Power Company joined in an application for an order authorizing the sale of the Elsinore Company's property in Riverside County to the Southern Sierras Company.

The Citrus Belt Gas Company, successor to the San Bernardino Valley Gas Company, applied for permission to issue $444,400 of bonds, $444,400 of par value of stock and $100,796.54 in notes.

Jan. 18.

The Kern County Merchants' Association filed a complaint with the Railroad Commission against the California Natural Gas Company and the San Joaquin Light & Power Company, charging extortionate rates to consumers in Bakersfield.

A. A. Weber applied for a certificate of public convenience and necessity to operate a gas plant in Dinuba, Tulare county.

The Los Angeles Gas & Electric Corporation applied for a certificate of public convenience and necessity to construct and operate a pipe line for artificial and natural gas in Los Angeles county.

Jan. 21.

E. W. Crosby of Reedley, applied for authority to sell his telephone plant to the Reedley Telephone Company. The telephone company, in turn, asked permission to issue 11,000 shares of stock of the par value of $1 per share.

The Tulare County Power Company applied for permission to issue $300,000 of bonds, to be used in refunding existing obligations and in enlarging facilities.

Jan. 22.

The Big Four Electric Railroad applied for authority to issue $400,000 of its capital stock, the proceeds of which will be used in the construction of an electric railway from Tulare to Visalia and from Tulare to Porterville.

"ELEMENTS OF WESTERN WATER LAW."

Reviewed by SAMUEL C. WIEL.

"Elements of Western Water Law," by A. E. Chandler, Irrigation and Water Right Specialist; Assistant Professor of Irrigation Institutions, University of California; Secretary American Engineering Corporation. I Vol.; 150 pp.; 1913. Technical Publishing Company, San Francisco, Cal. Price $2.00.

Mr. Chandler's book, the chapters of which were published as separate articles in the Journal of Electricity, Power and Gas, presents in abbreviated form part of a course in "Irrigation Institutions" given to advanced students in the Colleges of Agriculture and Civil Engineering of the University of California. In treating the matters involved, quotations are freely given from adjudicated cases and statutes. It is convenient and concise in form, and the author has accomplished a valuable service to irrigators, power and mining men and civil engineers who wish a better insight into the law of waters.

The West has been developed upon the principle that possession makes law. From the days when Captain Bonneville, in the thirties, led his fur-trading companies into Montana to take pelts where he found them; later when the Mormons seated themselves upon a wide expanse and claimed it as an independent state by right of occupancy; through the days of "forty-nine" when miners staked out claims in the mountains and guarded them as their property by right of discovery, while immigrants in prairie schooners went into the valleys and claimed them as their own; down to today, when men post notices upon streams and claim the waters by right of first possession, the West has developed itself by having the first who came along take so much as he could beneficially use. In the Western water law this principle has specially entrenched itself.

Where possession is the law, ownership in its absolute sense is subordinate. Controversies are settled upon whether you had the thing when your opponent came and took it. Perhaps you yourself had taken it in turn from a third person, but no matter. Between you and your own opponent it is enough if you were first in possession, even though the third person could recover it from both of you. A possessory law is only a law of "better right," in its comparative sense, and settles controversies in this way "for better or worse," without looking for any "best right" that would bind the world in the sense of entire ownership.

The law of prior appropriation of water which, as set forth in Mr. Chandler's book, today so largely exists in the Western regions, grew out of this development of the West by taking possession of things, and it is a possessory law of this kind. The statutes usually enact that among appropriators priority gives the "better right." An appropriator may thus be adjudged to have no right against a prior appropriator, while he may be adjudged to have a "better right" to the whole stream than some later appropriator. For example, A, B, C and D have located upon a stream in their respective order, each claiming the whole flow. A sues B, and, being a prior appropriator as to B, gets a decree for the whole flow against B. In turn B sues C, and, being a prior claimant as to C, gets a decree for the whole flow against C. In like manner, C gets a decree for the whole flow against D. If you collect these decrees, you think the court has decreed the stream to flow three times its actual capacity. But the court has decreed the actual ownership of none of the water. That could be done only if they were all involved in one suit, which seldom happens. It has decreed only the "better" right between the individual disputants in each separate case, without actually settling the final ownership in any one.

That is a common situation under a possessory law. To relieve the situation, Mr. Chandler's book indicates (pages 56, 77, 148, 149) the sentiment, which is growing in strength, of having all appropriators upon a stream determine their claims all in one action and not separately. The new legislation, of which Mr. Chandler is a leading advocate, makes special provision for such a comprehensive suit to be brought upon every stream in the state. It would be a clean sweep whose effect would last for numerous years. Still, rights under a possessory system will continue to shift by abandonment, sale, or new appropriation or in other ways after the stream has been decreed, and where there are a hundred or more usuers upon a stream which has been decreed from source to mouth once. it is not possible to have it decreed over again every time any two of them get into a quarrel. When such a private quarrel then arises the determination must return to the possessory basis of "better" or "worse" right as between the two, binding no one else, and even though both are claiming more than they would be entitled to against others upon the stream. The test of "better or worse" remains the foundation of a possessory system of law.

There is another system of water law having some existence in the West, which is not a possessory system of "better right"; but a system of "best right" good "against the world" and called "the common law of riparian rights." Under it all landowners upon a stream's banks own the stream in common against every one else. Under this system there is no one who can have a "better right" than a riparian owner, unless by grant, condemnation or prescription, or other exceptional circumstance.

The riparian system and the possessory law can exist together in the same state at the same time. The fact that the "best right" is in the riparian owner will not prevent several appropriators, who have nevertheless diverted the water, from having "better" and "worse" (or prior and subsequent) rights among themselves, even though the riparian owner has the best right of all. That is the situation in California.

In California the chief questions at present arise out of the two matters indicated. Legislation was offered at the last session of the legislature, and will be offered at this one, to provide a special determination for each stream in the state as a whole, bringing all users into one proceeding. To secure the most benefit from such proceeding there should go with it, as Mr. Chandler shows to be the practice in other states, a system for central control by a state office over enforcement of the decree when rendered, and over the filing of new claims in the future; otherwise the determination will grow unserviceable by wear and tear after it is made. The other question at present arises out of the riparian doctrine, which Mr. Chandler strongly opposes, but believes too dangerous to experiment with. He is certainly justified in thinking that it is a matter to be approached cautiously.

Mr. Chandler's book represents original work and thought upon the law, which should enable his readers to get sounder ideas upon it than have heretofore been current. The legal authorities to which the author refers are leading cases selected from the author's independent investigation. The advantage has been his of going frequently over the subject in his university courses, an unusual aid to orderly statement and arrangement; while as a former state engineer of Nevada and now a practicing engineer connected with the installation of extended projects, his experience enables him with marked success to select in a comparatively small compass the chief points of interest to men engaged in the practical side of water development.

"Audel's Answers on Practical Engineering." 254 pp., 4½x6¼ in. Published by Theo. Audel & Co., New York, and for sale by Technical Book Shop, San Francisco, Price $1.00

This text is written for engineers, machinists, firemen and electricians planning to take an examination for an engineer's license. It consists of a series of practical questions and simple answers on the care of boilers, pumps, injectors, engines, indicator, safety valve, the dynamos, etc., the thought being in the question, the information in the answer. It fills the purpose admirably.

INDUSTRIAL

THE COOPER HEWITT QUARTZ LAMP.

The quartz lamp represents an additional commercial development of the principles involved in the vapor lamp invented by Dr. Peter Cooper Hewitt. In principle, the difference between the standard Cooper Hewitt lamp and the quartz lamp is only the greatly increased pressure of the luminous vapor in the latter. The standard Cooper Hewitt lamp is not ordinarily run at a higher density than a pressure equal to about ⅛" mercury column, while the pressure in an operating quartz lamp may be that of the atmosphere or higher with the result that the temperature in the luminous vapor is extremely high.

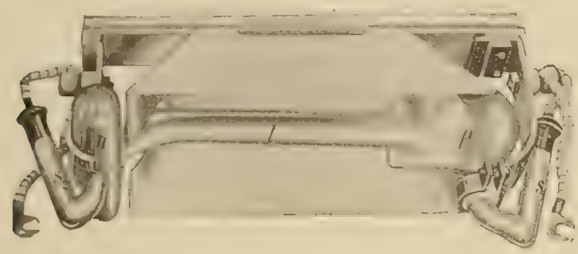

Fig. 1. Quartz Burner No. 49449.

The ordinary Cooper Hewitt lamp and the Quartz Cooper Hewitt lamp, in spite of having been built upon the same physical foundations, represent, from the practical point of view, two contrasting types; the one possessing great area of luminous surface with a consequent small intrinsic brilliancy and so low a temperature that it may be considered near the "cold light" of the scientist; the other with a radiant of small surface giving a very concentrated and intense light and working at very high internal temperatures.

Besides the discontinuous spectrum characteristic of mercury, the quartz lamp, owing to the high temperature, emit, like incandescent bodies, also a luminous spectrum, and it is due to this circumstance that the light of the quartz lamp

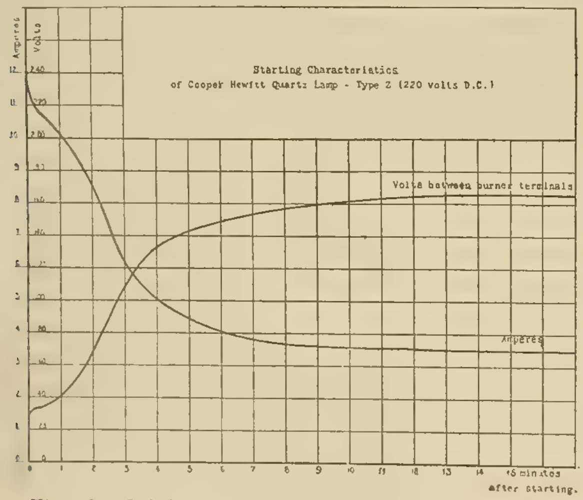

Fig. 2. Original Starting Characteristic Curves.

contains, besides the predominant yellow, green, blue and violet lines of the mercury spectrum, red and orange rays, there being more of the latter the higher the vapor temperature.

A vacuum container for the direct current Cooper Hewitt quartz lamp is shown is Fig. 1. Its main part is the tube "t" carrying the luminous vapor terminating on one (the positive) end in an enlargement "p" and on the other (negative) end in the lateral tube "n." Mercury in each enlargement forms the two electrodes, which receive the electric current by small upright U tubes "s_1," "s_2." Rods of slightly conic shape of a special alloy are ground into a wall of these upright tubes, and the joints are covered with mercury which again is closed in by a layer of a suitable compound to prevent access of air and prevent the mercury from being spilled or vaporized.

When a cold quartz lamp is started it requires, owing to the small drop of potential at the low pressure, a rather high current and the whole cross section of the luminous tubes of the burner is filled with the pale bluish-green light. But presently, as the lamp warms up, the appearance changes; the light recedes from the walls and, with increasing vapor pressure, becomes concentrated in the center of the tube in a thin dazzling path; the current at first steadily dropping, becomes stationary, and the appearance of the light assumes a whiter color with a visible gain of red and orange rays as the lamp attains its temperature of operation. The change of the lamp current, and the voltage of a 220-volt, 3.5-amp. Cooper Hewitt quartz burner with reference to the time after starting is shown in Fig. 2.

The essential parts of a commercial quartz lamp outfit are the following:

A series resistance for regulating the burner voltage and making the lamp adaptable to a wider range of supply voltage;

A series induction for steadying the arc:

A glass globe to prevent too rapid a dissipation of heat from the burner, and to absorb the ultraviolet rays.

And, if the lamp is to be automatic, a starting device.

The ultraviolet rays in which the mercury arc is especially rich, and which are readily transmitted by quartz, may be considered injurious to the eyes for a short distance. The most actinic of these rays, i. e., those with the shortest wave length, are absorbed by passing through a few inches of air; but all are completely absorbed by common glass, so that a surrounding globe of clear glass affords absolute protection from these rays. The bactericidal and physiological effect of the ultraviolet rays is too well known to be dwelt upon here, but has no effect when the light has passed through a glass globe. When a quartz lamp is used for the purpose of the generation and utilization of ultraviolet rays, no glass should be inserted in the path and the lamp should be placed as close as possible to the exposed object.

Two types of Cooper Hewitt quartz lamps are manufactured for multiple connection on d.c. lines—one for 110 and the other for 220 volts. From a.c. supply circuits they may be operated through the medium of the Cooper Hewitt rectifier.

NEW CATALOGUES.

Fairbanks, Morse & Company are distributing a most unique device known as a Current-O-Scope, which graphically exhibits the relation of the instantaneous values of an alternating current in a three-phase circuit and how they combine in the windings of a three-phase motor to produce the revolving field.

The Electric Storage Battery Company has published four booklets, uniform in size, dealing with the use of Exide Batteries in automobiles. These include starting and lighting batteries, ignition batteries and batteries for electric vehicles. Two of the booklets consist of testimonial letters from satisfied users.

NEWS NOTES

INCORPORATIONS.

MARCUS, WASH.—The Marcus and Kettle Valley Company has been incorporated for $15,000.

MODESTO, CAL.—Empire Telephone Company, $14,000, subscribed $1400, by S. S. Keller, C. F. Rinehart, F. M. Fike, W. H. Shirk and L. E. Miller, all of Empire.

MODESTO, CAL.—Farmers' Telephone Exchange Company, $10,000, subscribed $14, by W. H. Hemminger, S. N. McBride, F. L. South, T. J. Crispin and J. M. Cross.

FRESNO, CAL.—Reedley Telephone Company, $25,000, shares $1 each, subscribed $50, by E. W. Crosby and D. C. Krehbiel of Reedley, Dr. G. A. Therker of Livermore, F. A. Baikin of Dinuba and Ira Dick of San Francisco.

ST. JOHNS, ARIZ.—Articles of incorporation have been filed for the Little Colorado Light & Power Company, by E. I. Whiting, Ernest Whiting, Herbert Berry and F. W. Brown. Capital stock is $20,000. Plans are already under way for a power plant five miles up the river.

FRESNO, CAL.—Articles have been filed here incorporating the Riverdale & Lanare Telephone Company, to operate a telephone line of four miles between the two towns named. Capital stock is $700. Directors are Alan Milnes and A. J. Van Cleef of Riverdale, and L. A. Nares of Fresno.

ILLUMINATION.

OGDEN, UTAH.—The board of city commissioners have passed an ordinance granting C. A. Boyd a franchise to build and operate a gas plant in this city.

POCATELLO, IDAHO.—Following a reduction in rates for light, W. Center street business men have started a movement to install cluster lights along that thoroughfare.

KETCHIKAN, ALASKA.—The Citizens Light, Power & Water Company, J. C. Barber, president, will double its present capacity by adding a 1000 horsepower unit to the present power capacity.

ARLINGTON, ORE.—As the result of the recent city election the town of Arlington is to be lighted with electricity. The question of the installation of a municipal light plant carried by a large majority.

PORTLAND, ORE.—The city council will receive bids up to February 25th for lighting the city of St. Johns in accordance with the specifications on file in the office of the city recorder, the contract to commence March 1, 1913, and to run not longer than five years.

SPOKANE, WASH.—Extensions and improvements by the Spokane Gas Company, as contemplated for 1913, and already under way, call for an expenditure of $120,000. A. N. Cantrill, manager of the company announced the letting of the contract, for $20,000 for electrifying the steam-driven machinery at the gas plant. The contract for electrical energy goes to the Washington Water Power Company.

SACRAMENTO, CAL.—No bids were received by the city commission for installing conduits for the electroliers of the city and the commissioner of public works will do the work with the city electrician's staff of workmen by day labor. It was expected that several bids would be submitted and that the work would cost approximately $10,000.

TULARE, CAL.—Following the sale of the Consolidated Heat, Light & Power Company of Visalia and this city and the Home Gas Company of Porterville, to the Central California Gas Company, J. W. White, representing the State Railroad Commission, is here looking over the books of the company. Mr. White states that the new gas company is taking steps to enlarge and improve its plant and business. Distributing mains will be located at Exeter and Lindsay.

NEWPORT BEACH, CAL.—The board of trustees have decided to build a distributing system out of the general fund, and buy current at wholesale from one of the big power companies. The city recently voted bonds in the sum of $25,000 to acquire the electric light plant of C. H. L. Ghriest, who put a price of $22,000 on the property, which was considered prohibitive.

LOS ANGELES, CAL.—Representatives of the Los Angeles Gas & Electric Corporation have submitted to the city gas and light committee two propositions, whereby that company agrees to bid for a street lighting contract. First, that on an 11 months' contract the company will agree to install 50 emergency lamps and replace up to 100 lamps; second, on a 23 months' contract the company will agree to install 750 additional lamps, and take care of a certain number to be replaced.

TRANSMISSION.

GRACE, IDAHO.—The Last Chance Canal Company is considering the installation of a hydroelectric power plant here to heat and light surrounding towns.

PORTLAND, ORE.—The executive board of the council is asking for bids for stringing the trolley wires on the Broadway bridge. All the street car apparatus will be installed by the city.

POCATELLO, IDAHO.—L. R. Martineau of Salt Lake, and J. D. Browning of Pocatello, have asked permission to erect an electric power transmission line from Lava Hot Springs on the Portneuf River over and along county roads in Bannock county.

RIVERSIDE, CAL.—Sealed bids will be received up to February 19th, by the board of supervisors for a franchise granting the right to construct and maintain for 50 years, piers, masts, poles and other appliances for transmitting electricity in Riverside county.

CONDEN, ORE.—Geo. Jacobs, well known as being extensively connected with electric power propositions throughout the northwest, was in this city recently looking over the field with the view of furnishing electric power and lights by means of a transmission line from a power plant on the John Day River.

SALT LAKE CITY, UTAH.—An application has been filed with the state engineer for the appropriation of 2370 second feet, 1,715,000 acre feet of water daily from the Green River for power purposes. The application was filed by Thomas W. Cameron, Theo. J. Winkelan, Frank D. Wyant and others, St. Louis capitalists. They plan to organize a power company to distribute power throughout Utah.

BLISS, IDAHO.—An active competitor for the supply of electric light and power in this field is the Beaver River Power Company of Utah, which has built and put in operation a 7500 kw. hydroelectric plant on Malad River, near Bliss, Idaho, and has built a transmission line, 85 miles in length, from the plant to Boise and Caldwell. In addition to this, the company has a steam-turbine generating plant in the city of Boise, 1750 kw. capacity. Substations at Caldwell and Meridian are under construction. It is stated the company has a 35-mile distributing system at Boise, part of which consists of underground wires. The main transmission line carries 44,000 volts. E. P. Bacon, Boise, is the company's Idaho manager.

BOISE, IDAHO.—The Idaho-Oregon Light and Power Company, which has hydroelectric plants at Swan Falls, on Snake River, Horseshoe Bend, on Payette River, and Barberton, on Boise River, has substations at Boise, Caldwell, Nampa,

Parma, Payette, Ontario, Nyssa, Weiser, New Plymouth, Emmett, Fruitland, Middleton, Star and Eagle. The same company is building a large generating plant at Oxbow, on Snake River, near Homestead, Oregon. Waterpower here has been made available by driving a tunnel at the Oxbow bend in the river. The work has progressed to the stage of readiness to install the water wheels and generators, and it is claimed the plant eventually will have 60,000 h.p. capacity. A subsidiary of this company is the Idaho Traction Company, which operates a 60-mile electric railway that makes a triangular circuit from Boise to Caldwell, thence to Nampa and back to Boise, via Meridian. Three cars are run in opposite directions, giving hourly service each way. The route from Boise to Caldwell is down the Boise River; that from Caldwell to Nampa parallels the Oregon Short Line, and the 22-mile line from Nampa to Boise traverses a mesa country. This loop is doubtless the nucleus of a larger system which eventually may include Payette and Weiser in its service. This centralization of electric power in Western Idaho and adjacent country in Oregon was effected by Mainland and associates of Wisconsin.

TRANSPORTATION.

MARTINEZ, CAL.—Fred E. Brooks has applied for two franchises for electric roads. One of the projected lines is to run from Martinez to Bay Point, and the other would enter Walnut Creek, Danville, thence south and east to Haywards, and thence to Livermore.

CLARKSTON, WASH.—At a meeting of the city council in Asotin the application of L. F. Strum for a franchise to operate an electric road at Asotin was granted. Mr. Strum has already secured franchises in Lewiston and Clarkston, and contemplates the construction of a line to serve Nez Perce and Asotin counties at an early date, and in time to care for the annual fruit crop.

SAN FRANCISCO, CAL.—Plans and specifications prepared by the city engineer for the extension of the municipal railway from its present Geary street terminus along Market street to Sutter and Sansome, where a connection is to be made with the outer tracks to the Ferry, have been approved by the board of public works. The materials for the roadbed already have been obtained by the board. The cost of construction is put at $27,000 by the city engineer, and a bonus of $150 a day is to be allowed the contractor for completion ahead of the contract time, the bonus being limited to 15 days. The supervisors have been requested to set aside $29,250 to cover the cost and possible bonus so that the contract may be let.

PORTLAND, ORE.—The Washington Electric Railway Company, A. Welch, general manager, plans to build three links in an electric railway system which will eventually connect Puget Sound cities as follows: From a point near Orchards, Wash., connecting with the line out of Vancouver, Wash., to the Lewis River, twenty miles north. From the present southern terminus of the line operating out of Chehalis, to the Cowlitz River. From the northern terminus of the line operating out of Centralia, to Olympia, a distance of twenty-six miles. In addition to this work, a new road also will be built from Vancouver to Camas, where are located the plants of the Crown-Columbia Paper Company, but this development will not form a part of the ultimate Portland-Seattle line. This will include the development of a 12,000 h.p. plant on the Kalama River.

LOS ANGELES, CAL.—Paul Shoup, president of the Pacific Electric, announces that arrangements have been made for the extension of the present Riverside-Arlington line to Corona. The new line will be nine miles in length, and when finished and equipped will represent an outlay of about $450,000. Property owners have agreed to arrange for the necessary right of way and terminal facilities, both in Corona and Arlington, and as soon as the deeds can be prepared the construction work will begin. Contracts have been let for the building of the link in the big loop from San Bernardino to Riverside by way of Colton. Progress also is being made in obtaining the necessary right of way for the construction of the line from Upland to San Bernardino. When these three lines are built, sometime within the present year, there will remain only a few miles of construction between Corona and the end of the present La Habra line to make the projected San Bernardino loop complete.

TELEPHONE AND TELEGRAPH.

MODESTO, CAL.—Wm. Schmidt has been granted permission to erect and maintain a telephone line aiong the county roads.

NELSON, B. C.—The British Columbia Telephone Company is preparing to build a line to Kaslo from the terminus of its present line along the west arm, to equip an exchange at Kaslo and to provide service for the intermediate districts, providing that sufficient subscribers to warrant the carrying out of the undertaking can be secured.

WATERWORKS.

NORDHOFF, CAL.—The Ojai Power Company has purchased the Nordhoff water system, and it is the intention of the purchasers to expend several thousand dollars improving the same.

OXNARD, CAL.—By decision of the State Supreme Court, the Oxnard $100,000 water bond issue is legal. The bonds will be advertised at once, and actual work will begin on the waterworks system as soon as possible.

RENO, NEV.—A waterworks plant for the lower townsite of Rochester is among the contemplated improvements planned by U. W. Harwood, William Borland, Cliff De Lorme and C. F. Campbell, owners of the Rochester site. The townsite company will install a pumping plant to pump water to a tank on the hillside from whence pressure will be secured for the entire town.

REDLANDS, CAL.—The $600,000 municipal water bonds voted by Redlands people, sold to the Torrence Marshall Company of Los Angeles, have been signed by Mayor C. H. Clock, and turned over to the purchasers. The city plans to make use of $400,000 of the issue at once, to purchase the Domestic Water Company and the Redlands Water Company's systems.

VALLEJO, CAL.—A special election at which the people will be asked to vote upon the proposition of bonding the city for improvements to the water system and for a new city hall will be held some time in April.

RIVERSIDE, CAL.—The city of Riverside will take over the domestic water system February 1, and pay interest of 5 1-3 per cent on $575,000, until the final payment is made. In case the city fails to sell the bonds by June 1st, it will return the water system to the company and account for the net income.

SAN DIEGO, CAL.—One of the most important decisions yet rendered by the Railroad Commission was that in which the commission upholds the contention of the city of San Diego that it should not be required to furnish water to adjacent landowners to be used for irrigation purposes. It deciding the case, the commission went at length into the question of priority in the public service of a water company. It decided that there can be no priority between jacent landowners to be used for irrigation purposes. In held, further, that the water utility and the commission may legally limit the number of consumers. The commission took the view of the municipality that the supply was not more than adequate for the present consumers within the city limits of San Diego. It held, therefore, that the city should not be compelled to supply outside territory.

PROFESSIONAL DIRECTORY

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

WANTED—Engineer wishes to get into communication with a good promoter. Should be experienced in the promotion of hydro-electric projects. Must have A-1 references and be in touch with capital. Good opportunity for competent man. Address No. 27, Journal of Electricity, Power & Gas.

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company
Air Compressers
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.
Alarms, Burglar
Western Electric Company
Alarms, Fire
Dean Electric Co.
Western Electric Company
Arms, Cross
Western Electric Company
Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.
Arms, Mast
Fort Wayne Electric Works
Asbestos
Johns-Manville Co., H. W.
Asbestos, Wood
Johns-Manville Co., H. W.
Automobile Accessories
American Ever-Ready Co.
Westinghouse Elec. & Mfg. Co.
Automobile Horns, Electric
Dean Electric Co.
Manhattan Elec. Supply Co.
Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Burners, Gas Lighting
Western Electric Company
Batteries, Storage
Electric Storage Battery Co.
Westinghouse Machine Co.
Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Bells, Magneto
Western Electric Company
Batteries, Wet
Pacific States Electric Co.
Western Electric Company
Boilers
"Babcock & Wilcox," "Stirling," Moore & Co., Chas. C.
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.
Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.
Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.
Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.
Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.
Building Paper
Paraffine Paint Co., The
Cable—Flexible, armored
Sprague Electric works
Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company
Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.
Castings, Steel
Columbia Steel Co.
Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.
Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.
Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.
Cleaners, Boiler Tube
"Weinland," Moore & Co., Chas. C.
Cleats, Porcelain
General Electric Company
Western Electric Company
Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.
Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Coils, Induction
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.
Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.
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Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.
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Geo.E.DowPumpingEngineCo.
"Smith-Vaile," Moore & Co., Chas. C.
"Le Blanc" Westinghouse Machine Co.
Conduit Construction
K-P-F Electric Co.
Conduit Fittings
"V. V.," Electric Agencies Co.
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Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.
Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
"Buckeye," Elec. Agen. Co.
Pacific States Electric Co.
Sprague Electric Works
Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company
Connectors
Drendell Electric & Mfg. Co.
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.
Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.
Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.
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The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.
Cord, Flexible Bell
General Electric Company
Pierson, Roeding & Co.
Westinghouse E. & M. Co.
Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Pierson, Roeding & Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company
Cord, Telephone
Kellogg Swbd. & Supply Co.
Pierson, Roeding & Co.
Western Electric Company
Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.
Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.
Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.
Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.
Drawing Materials
Post Co., The Frederick
Drills, Electric
Fort Wayne Electric Works
Dynamos, A. C.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Dynamos, D. C.
Crocker Wheeler Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.
Dynamometers
Sprague Electric Company
Economizers, Fuel
"Green," Moore & Co., Chas. C.
Elevators
Van Emon Elevator Co.
Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Tracy Engineering Company
Westinghouse Machine Co.
Engines, Steam
Fairbanks, Morse & Co.
"McIntosh, Seymour," "Fleming," "Ideal," "Hooven, Owen & Rentschler," Moore & Co., Chas. C.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
"Ridgeway," Tracy Eng. Co.
Westinghouse Machine Co.
Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.
Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.
Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.
Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Filters, Oil
"Turner,"Moore & Co.,Chas.C.
Westinghouse Elec. & Mfg. Co.
Fixtures, Ceiling, Bracket, Etc.
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Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
"White." Elec. Agencies Co.
Fixtures, Marine
Benjamin Electric Mfg. Co.
Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.
Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M Co.
Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.
American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.
Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.
Blake Signal & Mfg. Co.
San Francisco, 44 Second
Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.
Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.
Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.
Century Electric Co.
San Francisco, 56 Natoma.
Columbia Steel Co.
San Francisco, 503 Market
Crocker Wheeler Co.
San Francisco, First National Bank Bldg.
Crouse-Hinds Co.
All jobbers.
Cutler-Hammer Mfg. So.
San Francisco, care of Otis & Squires, 579 Howard St.
D. & W. Fuse Co.
All Jobbers
Davis, R. J.
San Francisco, 60 Natoma
Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second
Dean Electric Co.
San Francisco, 156 Second
Dow Pump'g Engine Co.,Geo.E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.
Economy Electric Co.
San Francisco, 444 Market
Egan, A. T.
Salt Lake, Felt Bldg.
Electric Agencies Company.
San Francisco, 247 Minna
Electric Appliance Company
San Francisco, 807-9 Mission
Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry
Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.
Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.
General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.
Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.
Hemingray Glass Co.
San Francisco, 726 Mission
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak
Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.
Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
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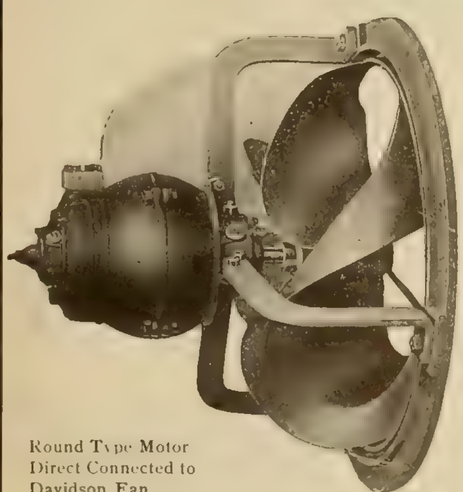

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Alphabetical Index to Advertisers, Page 8. — Where to Buy It in the West, Pages 9, 10

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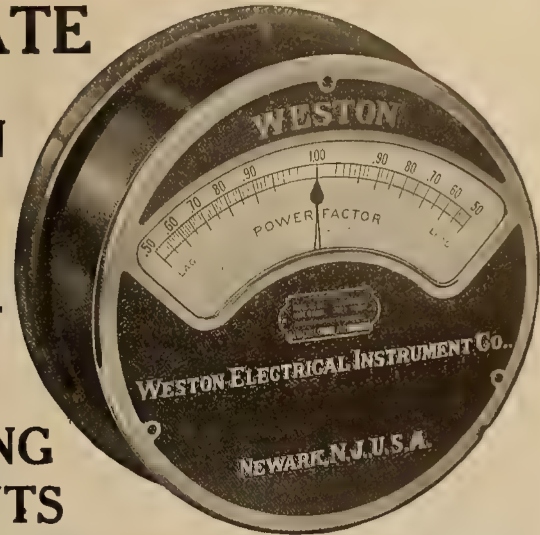

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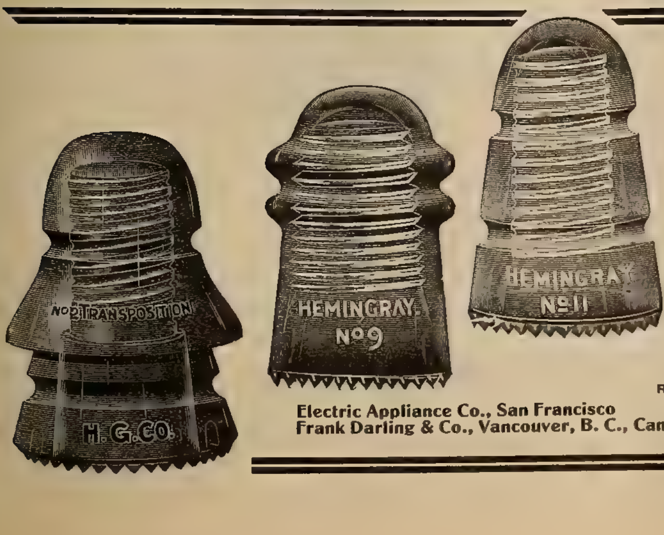

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX SAN FRANCISCO, FEBRUARY 25, 1913 NUMBER 6

COSTS OF PUMPING WATER AT ISLETON

BY A. F. BRIDGE AND RALPH REYNOLDS.

An interesting result of modern long distance transmission of electrical energy is found in the Sacramento Valley delta district.

Water is diverted from its habitual course in the Feather River and passed through Francis turbines. The power thus obtained is transferred some hundred miles down stream where it is utilized to pump this self same water back into the original channel. This seemingly wasteful use of water is due to the tremendous agricultural value of river bottom land.

The lower end of the great Sacramento-San Joaquin River system is a net-work of sloughs, canals and streams, which spread over a great triangle between the two rivers, with its apex at the lower end of their confluence. The innumerable islands formed by these intermingling channels are very low, due to their alluvial character.

The value of the soil in the upper portion of this district, from the farmers' standpoint, was early realized and even in the pioneer days of California, great crops of wheat were loaded upon sternwheelers and shipped down to San Francisco, thence to consumers all over the world. When the land would no longer produce wheat, the farmers turned to other things; such as fruit or alfalfa. This movement gradually led to the reclaiming and developing of the islands lower down and which had hitherto been considered uninhabitable, because of the danger of floods. There is, hence, in this region a large acreage of what is claimed to be the richest land in the world, devoted to the cultivation of alfalfa, fruit, asparagus, hops and potatoes, a checkerboard of farms interlaced with navigable channels, which bring cheap transportation facilities right alongside.

Sacramento River Scene Near Isleton.

To snatch these prizes from under the Sacramento, it was necessary to build high levees and install large pumping plants to remove surplus water during spring freshets when the Sierra snows are melting rapidly.

These protective embankments have given the country its name—"The Netherlands." There are Dutchmen there, too, as well as Chinese, Japs, Hindus, Portugese, and occasionally a Native Son.

These "reclamation plants" as they are called, are somewhat of an improvement over the old dutch windmills which have proven too unreliable for the modern farmer. Floods are liable to come in a few hours.

Low pressure (reciprocating) or plunger pumps, direct-connected to steam engines were the typical early installations. Such plants represented a large investment and required skilled attendance, but they were all that were available until quite recently.

Island District of the Sacramento and San Joaquin Rivers.

The farmers soon began to "go nature one better"—to force their crops by irrigation. The islands are mostly above the river level during its low stage, which coincides with the irrigation season. Hence, it is necessary to raise the water. The customary outfit for this work was a single cylinder gas engine of from 2 to 20 h.p., driving a low head centrifugal pump. These irrigating plants are a more recent development, and while they operate for a longer period, the capacity is usually far less than that of the reclamation pumps. These latter vary from 75 to 500 h.p. and are designed with a large safety factor with regard to size, since in case of floods it is extremely desirable to have a pump capable of handling the water in any emergency.

Both types of equipment were satisfactory in operation and each well adapted to its particular purpose. Competition has, however, entered the field in shape of cheap and reliable electric power. This is due to the advent—within the last few years of the Great Western Power Company's transmission system—a new and enterprising concern which has lately constructed a maze of lines in this region as complex as the river itself.

The main line, a double circuit 100,000 volt system, passes through the region in a general north and south direction. The Great Western Power Company, realizing the market for power in this vicinity, erected a substation near Isleton at the southern extremity of a 1600 ft. span across the river. Here three single-phase General Electric, water-cooled shell type, 23,100 volt transformers are connected in delta to the high tension line.

The Substation.

The station is a steel frame structure covered with galvanized corrugated steel sheets. The primary leads enter the station through porcelain bushings supported in the roof. They run to a Thomson, manually operated, remote control, oil switch, located immediately behind the transformers, which are interconnected on the high side by short leads or jumpers. The transformers are located in the center of the building and carried on rails embedded in the concrete floor. This permits of any of them being slid forward, and under a chain hoist where the coils and core may be readily removed for inspection or repairs. The cooling water is forced by gravity through the coils from a steel tank outside the station and discharges into the river. Telltale check valves are so placed in the pipes as to be easily visible to the operator and serve to indicate any cessation of the supply. The secondaries connect directly to a 2300 volt transformer bus without any intervening switches. The feeder bus is separated from the transformer bus by a K-21 General Electric oil switch. The transformers are protected against high frequency surges by aluminum cell lightning arresters. Taps are taken off the transformer bus through choke coils to the arresters, which are set in a concrete base just outside the station. These are fitted with arc rupturing horn gaps in accordance with latest practice.

From the feeder bus, lines connect with Brighton, Venice Island and the northwestern division through Rio Vista and Napa. These circuits are all controlled by K 12 General Electric oil switches. Just south of the building an auxiliary bus mounted on poles and arranged to connect the transformer bus and all the 23,000 volt feeders through pole top, air-break switches, thus affording a simple means of completely isolating the feeder bus to facilitate alterations and repairs.

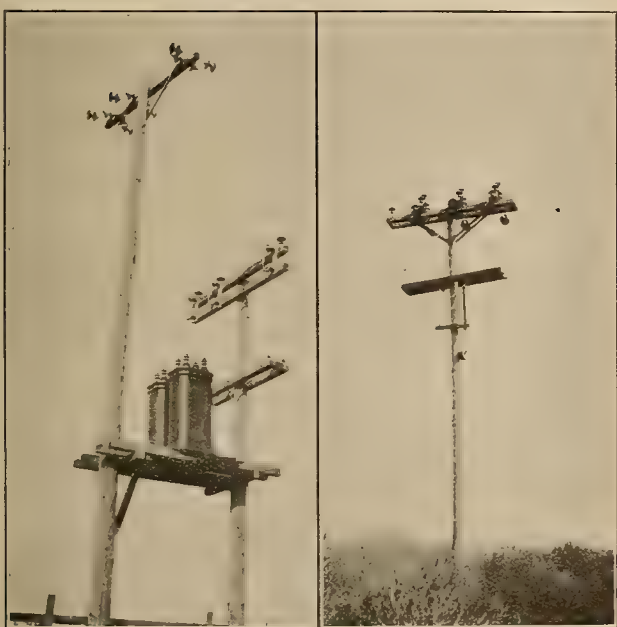
Power is taken from the feeder bus through K-12 oil-breakers for 3 delta connected, 50 k.v.a., 23,000/2300 volt oil-cooled transformers. These are inside the station and furnish 2300 volt service over a 3 mile line to Isleton and the vicinity of Walnut Grove.

The feeder switches, sectionalizing switches and instrument transformers, are mounted along the south wall on a steel frame structure. This also supports the bus and suspension insulators from which the various circuits are led through outlet orifices in the south wall. An instrument panel is placed immedi-

ately below each switch as is also the automatic overload tripping device.

Totalizing and 2300 volt feeder panels are located opposite the center of the bus structure, the instrument taps being led through conduits below the floor. Each feeder panel is equipped with polyphase indicating and integrating wattmeters and the station total output panel contains ammeters for each phase, a curve drawing wattmeter recording and indicating volt meters.

View of Isleton Substation Showing Auxiliary Bus and Pole Top Switches, Dead Ending of High Line Taps With Crossing Tower in Back Ground.



Pole Switches With 2300 and 23,000 Line Construction.

Distributing System.

The lines mentioned above are at present constructed and in operation and the system is being rapidly extended so as to form a comprehensive network throughout the entire valley. The development is according to a well formulated plan. The 23,000 volt lines form the trunk or distributing mains and radiate from the Isleton station to points determined by the local consumption.

Here outdoor 23,000/2300 substations are located which tap off from the mains and feed the secondary 2300 volt busses. These substations are uniform in their construction and consist of 2 oil-cooled transformers with capacity from 75 to 150 kw. They are mounted on a wooden framework between two poles and elevated some 10 ft. from the ground. Primaries and secondaries are V connected, the former through pole switches. No protection from the elements is attempted and so far no interruptions of service have occurred due to injury from rain, etc. These installations are in reality large pole transformers and resemble them in every respect. The 2300 volt lines are usually about 2 to 6 miles long and supply power for pumps through 2300, 220-440 volt open delta pole transformers located at the point of consumption. With few exceptions the energy undergoes four transformations of pressure before being utilized—11,000/90,000/23,000/2300/220.

Submarine Cables.

The circuits are all carried on pin type insulators supported by double cedar cross-arms and poles of 50 ft. average height. All three conductors are mounted on the same cross-arm and are not transposed. In many instances and wherever possible the same pole line serves for both 23,000 and 2300 lines, the former being carried on the upper cross-arm. Where it is necessary for the trunk line to cross a slough of considerable width or one open to navigation a three core sheathed submarine cable is laid. These have given excellent service but are occasionally damaged by logs, anchors, etc. The Venice line feeds the southern part of the district. The Brighton feeder supplies the region north of the river and extends to the Brighton substation via Glide, thus linking this station and Isleton substation together. In emergency, Brighton may feed back and supply the northwestern division through Isleton but at the expense of good regulation, since under these conditions the line drop is excessive. The Rio Vista line carries power into the northwestern division extending as far as Santa Rosa.

Owing to the rigid requirements of the reclamation service the power company is now engaged in rapidly tying together both their 23,000 and 2300 volt lines so that any point may be fed over two or more independent routes. Thus the insurance of continuous service to any one consumer is multiplied. The additional reliability fully warrants the increased expenditure.

Load.

The connected load of the Isleton station on the basis of installed capacity consists of about 150 kw. in lighting and 2426 h.p. in pumping plants of various kinds. This latter comprises the greatest part of the load and consists of two classes, reclamation 12,425 kw. and irrigation 627. The former represents only 11 installations, however, and the latter 68, with average capacities of 113.0 and 9.25 kw. respectively.

Reclamation.

Practically all the reclamation plants are owned by organized districts incorporated by private enterprise. They are formed for the purpose of draining the land owned by the stockholders. This load is strictly of a 24-hour nature during the flood season and hence can not be dropped over the daily peak.

Some of the reclamation pumping plants have been in operation for 20 years. The process of reclaiming the land consisted of building a levee around an island and then pumping out the water, hence

every new island that was opened up had its own equipment. Five years ago all of these were driven by steam engines burning oil fuel. The first cost of the plant of this character was high. This was inherent in the steam plant on account of the cost of auxiliaries—feed pumps, boilers, oil pumps, condensers, etc. The cost of maintenance and attendance was also a considerable item since a competent steam engineer was required to properly operate the plant.

Ryde Plant.

A brief history and description of one of these will illustrate the general type of installation. The Ryde plant was installed 19 years ago at Ryde on the south side of Grand island when the island was first being drained. As originally placed in commission, the plant consisted of a 44 in. B. J. single-stage cen-

Pump Placed Outside of Levee at the Ryde Plant.

trifugal pump, direct connected to a B. J. 2-cylinder cross compound steam engine. The pump operated at 160 r.p.m. and discharged 42,000 g.p.m. into the river through a 44 in. pipe line under the levee.

The indicated h.p. of the engine when the pump is discharging against a net head of 13 ft. is 210. The normal pumping period is approximately six months, beginning in December. However, this is subject to tremendous fluctuation depending on the precipitation of snow and rain. For instance in the season 1911-12 no pumping was necessary at all, in 1910-11 the plant was in operation practically throughout the entire year. The average total annual operating cost taken over a period of five years, with this equipment was $1400.

This year a duplication of motive power has been made in the shape of a 350 h.p. type I, 440 volt, 360 r.p.m. General Electric induction motor. This is arranged to drive the pump through a 36 in. rubber belt and a 90 in. pulley on an extension of the engine shaft, as shown in the illustrations. This motor drives the pump at 170 r.p.m. at which speed the normal delivery is 45,000 g.p.m.

Multigap General Electric arresters are employed as protection against high frequency surges. A 12 in. x 16 in. triplex Gould vacuum pump is used to prime the suction line. It is belt driven by a General Electric 5 h.p., 440 volt induction motor.

The power is obtained from the 23,000 volt distributing line and stepped down in 3-100 k.v.a. oil-cooled transformers located in a small galvanized shed separate from the pump house.

During the summer months it is necessary to irrigate this island and this is accomplished in a unique manner. The connecting rods of the steam engine are removed and the flange coupling, through which the motor drives, disconnected. The discharge line is then primed through a bypass to the vacuum pump and water is siphoned in from the river, the pump runner revolving freely in the reversed direction as a turbine.

It is intended to keep steam on the boilers continuously during the wet season to prevent cessation of pumping in case of any failure of the power supply. As regards comparative operating costs no data is at present available since the motor has not been in active operation as yet. However, the rate schedule of the power company is based on the monthly load factors with a minimum of $6 per h.p. per year of maximum demand. Thus the minimum charge possible with the pumping is about $1400. It may readily be seen that no saving in this item has been made, and in addition there are the maintenance and attendance charges on motor besides the cost of keeping steam on boilers. However, the presence of the motor and steam drive is effective insurance against loss of property by flood and as such the owners are more than willing to pay the additional cost provided the service is dependable.

Smith-Riddell Plant.

Another installation, owned by the Smith-Riddell Company, is at Lisbon. Here a 75 h.p. General Electric 220 volt motor is connected to a 15 in. Krogh single stage, heavy duty double suction, centrifugal pump having 20 in. suction and discharge pipes. The costs of this plant are itemized as follows: Motor, $642; starting compensator, $7.62; casing, $450; pump, $613.43; labor for erection and foundation, $200; labor digging ditch through levee, $75. Total, $1987.05, or in round numbers, $2000.

This may be considered as typical of the new electric drive pumping outfits.

The plants are universally of this general character throughout the island country and when considered separately and purely from a load factor standpoint they are not especially desirable to the power company. When this demand is combined with the irrigation load, however, the annual load curve is smoothed out considerably. This fitting together is the result of the wet and dry seasons. The draining period runs from December to April, while the irrigation season for most crops, lasts from June to October. Oftentimes they overlap.

Irrigation.

Irrigation is usually carried on by small plants operated independently by the farmers, except in the interior of some of the large islands and on the high lands in the vicinity of Galt and Lodi, where the water is taken from the river. The maximum lift is 20 ft. and ranges down to 6 ft., depending on river height.

In former years it was common practice to lay the suction pipe through the levee. The advocates of this method claimed lower first cost of pipe; no siphon to prime in case air leaked in; reduced friction head; and fewer joints and elbows. However, it was found in practice that if the pipe through the levee developed a leak in time of high water, such an arrange-

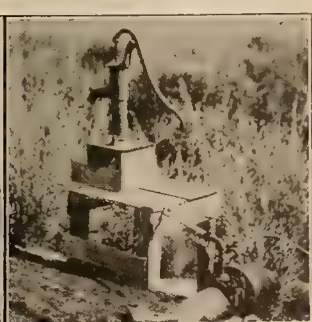
ment might cause a disastrous break in the dyke. Another disadvantage arose that unless this insertion was protected by a concrete bulkhead, on each side, the rats and gophers burrow through alongside the pipe and weakened the levee. Repairs to the pipe line are expensive since a large amount of excavation must be done. For the public safety laws are now in effect which do not allow placing the pipe more than 3 ft. under the levee.

In some places, the pump is located outside the levee with the suction pipe vertical and discharging over the levee. More frequently the pump and motor are housed on the inside and the water siphoned over. The first has the advantage of less priming, a minimum of leaks in suction pipe, and fewer joints, but it is liable to submersion during high water, and since safety of the outfit is the determining factor, the pump should be protected by the levee. There are some thirty irrigation pumps now in operation in the islands of which more than 75 per cent are motor driven. Of these, all are belt driven with one exception. The advantage of this form of drive over direct connection is that, by changing pulleys, the pump speed may be altered to suit the variation in head. A high speed motor, about 1700-1800 r.p.m., may also be used. Thus a cheaper motor and a stock pump may be successfully employed, whereas with direct connected outfits a special pump design and expensive slow speed motor are required, even where the head is constant. From 5 to 15 per cent of the transmitted power is consumed in belt slippage.

Andrus Island Plant.

The outfit of the Andrus Island Company, which is shown in accompanying illustrations is a good representative of the type of plant used. It is located on the south bank of the river near Isleton, and is contained in a galvanized shed inside of the levee. This is a 10 h.p. Westinghouse, 220 volt motor, driving a 6 in. Eclipse pump through a belt. The net head is low, about 8 ft. The suction pipe runs up over the levee as shown and an ordinary hand lift pump is used to prime the suction line. The pump and motor are mounted on a concrete foundation and the

Suction and Discharge Lines with Sump, Andrus Island



Hand Lift Priming Pump on Top of Levee Andrus Island

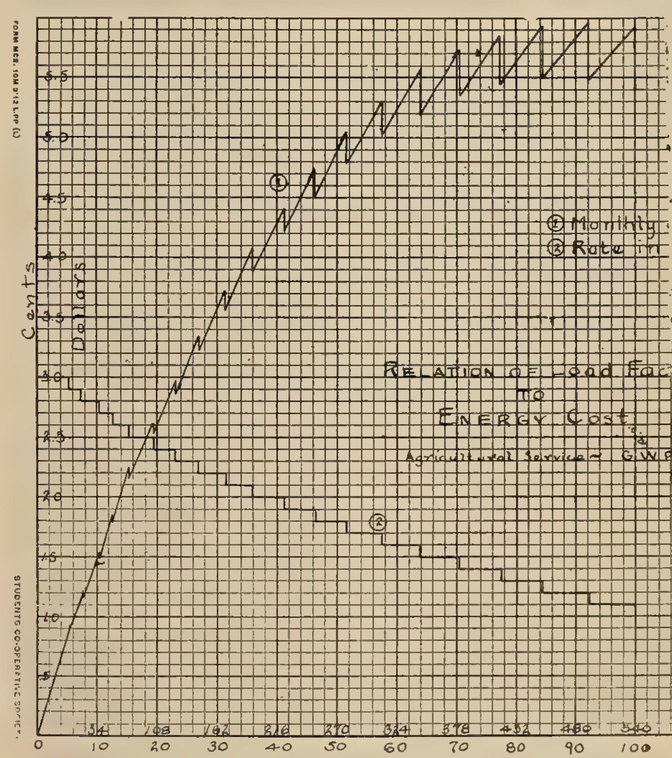
starting compensator switches and fuses are carried on a wooden wall panel. The discharge pipe terminates in a concrete pump from which the water is distributed by gravity ditches. The suction line is of 17 in. flanged casing about 90 ft. long and discharges some 9000 gallons per minute.

The over-all efficiency of the plant is itemized as follows:

Pump	63 per cent.
Motor	87 per cent.
Resultant	54.7

This is exclusive of loss in transformers and connections as it should be since the energy consumed is metered at the motor and such losses are not chargeable to the consumer. The cost of energy is determined according to the following schedule based on the load factor and is uniform for this character of service.

Monthly Consumption.	Monthly Charge per h.p. installed.	Load Factor.	Rate per kw.-hr.
Less than 31 kw.-hr. per h.p.	$0.00 0.93	0- 5.6%	3c
From 31 to 42 kw.-hr. per month.	0.90 1.22	5.6- 7.6	2.9c
" 42- 55 " " "	1.18 1.54	7.6- 10.2	2.8c
" 55- 70 " " "	1.49 1.89	10.2- 12.9	2.7c
" 70- 86 " " "	1.82 2.24	12.9- 15.9	2.6c
" 86-105 " " "	2.14 2.62	15.9- 19.5	2.5c
" 105-124 " " "	2.52 2.98	19.5- 23.0	2.4c
" 124-146 " " "	2.86 3.36	23.0- 27.0	2.3c
" 146-169 " " "	3.22 3.72	27.0- 31.3	2.2c
" 169-194 " " "	3.55 4.08	31.3- 36.0	2.1c
" 194-221 " " "	3.88 4.42	36.0- 41.2	2.0c
" 221-250 " " "	4.22 4.75	41.2- 46.3	1.9c
" 250-280 " " "	4.50 5.04	46.3- 51.8	1.8c
" 280-312 " " "	4.76 5.30	51.8- 57.8	1.7c
" 312-346 " " "	5.00 5.54	57.8- 64.0	1.6c
" 346-381 " " "	5.19 5.72	64.0- 70.5	1.5c
" 381-418 " " "	5.33 5.85	70.5- 77.5	1.4c
" 418-457 " " "	5.44 5.93	77.5- 84.5	1.3c
" 457-498 " " "	5.48 5.96	84.5- 92.2	1.2c
" 498-540 " " "	5.48 5.94	92.2-100.0	1.1c
" 540 " " "	$5.40	100.00	1.0c



Relation of Load Factor to Rate per kw.-hr., and Total Monthly Charge per h.p. of Maximum Demand.

A minimum fixed charge of $6 per h.p. yr. is made.

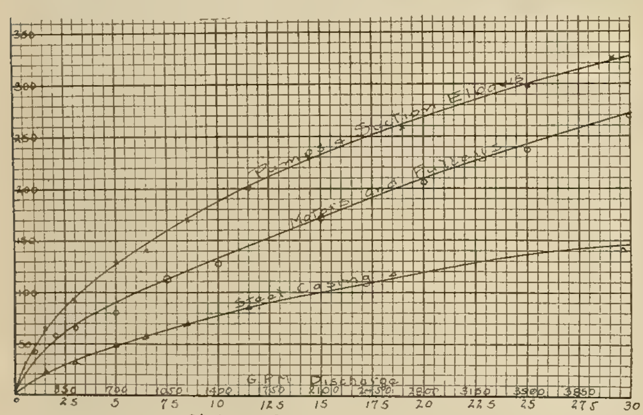
The load factor for such consumers is defined as the ratio of average load (taken over a period of 1 month) to the maximum possible demand of the in-

stalled apparatus. This necessitates testing of the plant to determine this consumption, which tests are made by the power company. Results show some variation due to the seasonal change in head. On account of the nature of the demand the fact that no winter irrigation is employed and the longest pumping season is 6 months, it is obvious that the yearly load factor can not exceed 50 per cent unless the motor is used for other purposes during the idle period. The load factor averages around 20 per cent.

Summary of Typical Plant.

1. Horizontal centrifugal pump, belt connected.
2. Three-phase, 220 volt, squirrel cage, induction motor, and starting compensator provided with no voltage release.
3. Rubber driving belt.
4. Foot or check valve.
5. Suction line, hand-operated, priming pump.
6. Overload release, fuses on both.
7. Motor switch (air break).
8. Piping (usually 1 in. larger than pump).
9. Shed, concrete foundations, pump, etc. The transformers and meter are supplied by the power company.

The first cost of a typical plant, a 6 in. pump, 10 h.p. motor, and all necessary equipment as itemized above together with 125 ft. of 8 in. flange, joint steel casing, installed complete with concrete foundations, is $575. The cost curves shown elsewhere represent the averages of some 60 plants in this region. The



Itemized Costs of Pumping Outfits Under Average Head Conditions.

Explanation of Curves.

The above chart is best explained by a concrete example. Suppose a farmer requires 1450 g.p.m., according to the curve the pump would cost $190, and the motor of 10.4 h.p., $133. But an eight-inch pump with normal delivery of 1600 g.p.m., is necessary and this will require a motor of 10.9 h.p. The nearest size is 15 h.p., hence the eight-inch pump costs $200 and the motor $169, a total of $369 actual, as against $323 from the curve. The cost of the house or shed which incloses the pump, varies over such a wide range, depending on whether it is of wood, galvanized iron or concrete, and the nature of the foundation that it is not practicable to incorporate it in the form of a curve.

average head is taken at 15 ft. with a motor efficiency at rated output of 88 per cent. They indicate the first cost installed and are fairly accurate. The initial investment is all that is available at present, since most of the pumps have been in operation for so short a time that no data has been obtained in operation and maintenance costs. From a few isolated figures, the conclusion is that for the load factors which usually prevail, the cost of operation alone is greater by about 10 per cent with motor than with an internal combustion engine burning distillate. This fuel is obtainable in this region at a rate of 10c per gallon, including freight. However, this is when the gas engine is new and at its maximum efficiency. With wear, loss of compression and leakage soon result. A motor does not deteriorate nearly as rapidly, neither should the two types of drive be compared on the basis of equal rating since the gas engine has no overload capacity, even instantaneously. The latter for a given possible output costs from 2 to 3 times as much as the equivalent motor, hence the interest on investment is often the determining factor in favor of the motor. The increased convenience, reliability and low attendance and maintenance charges are the best arguments in favor of electric drive and appeal strongly to the farmers.

Past and Present in the Pumping Art.

In conclusion, as most of the land available is at present under cultivation, growth and increased output is only obtainable by intensive farming which may be the best accomplished by careful irrigation. Water is plentiful and the probable growth of the demand for electric power in this region seems limitless.

CONCESSIONS AT THE PANAMA-PACIFIC EXPOSITION.

According to Director of Concessions Frank Burt, more than twenty-four concessions have already been granted by the 1915 Exposition. Of this number some of the leading attractions will expend $1,505,000 in preparing for the entertainment of thousands of visitors who are coming to the Panama-Pacific International Exposition. Following is a partial list:

Name.	Concession.	Amount to be Invested.
Remington Typewriter Co.	Public Stenographic Booths	$ 150,000
Santa Fe Railroad	Grand Canyon of Arizona	250.000
Drs. Couney & Fischel	Infant incubators	25,000
L. E. Myers	Panama Canal	150,000
L. E. Myers	Panamanian Souvenirs	25,000
Dale, Davis & Lewis	'49 Camp	100,000
Orange Blossom	California Candies	10,000
Patrick Brothers	Ice Palace and Hockey Arena	150,000
Pacific Aeroscope Company	Aeroscope	100,000
Marcel Clessinger	Trianon	60,000
E. W. McConnell	Creation	160,000
E. W. McConnell	Evolution of the Dreadnaught	150,000
E. W. McConnell	Cyclorama Battle of Gettysburg	25,000
E. W. McConnell	Human Roulette	15,000
L. A. Thompson	Scenic Railway	60,000
L. A. Thompson	Racing Coaster	60,000
C. L. Seipt	The Old Mill	15,000
Total		$1,505,000

ELECTRICAL PUMPING AND IRRIGATION

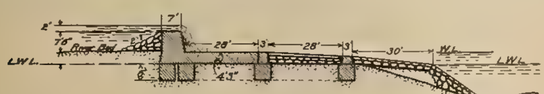
DIVERSION WEIRS ON PERVIOUS FOUNDATIONS.

BY B. A. ETCHEVERRY.

The construction of diversion weirs on pervious foundations has usually been based on the design of existing structures of the same type and under the same conditions, modified according to the judgment and experience of the engineer. The principles which should control the design of such weirs have been more or less empirical. In a recent book on the Practical Design of Irrigation Works, the author, W. G. Bligh, a retired executive engineer of the Indian Public Works Department, has evolved principles of design for such works based largely on the dimensions of successful structures in India. These principles, as well as experiments on the passage of water through sand by Lieutenant-Colonel J. Clibborn of Roorkee, India, while derived from practice in India, are no doubt applicable to similar conditions in other regions.

Types of weirs.

The diversion weirs on sand, used in India, are of three types: (1) those which consist of a direct fall on an apron; (2) those which consist of a low wall with an upstream floor extending from the stream bed and sloping up to the crest of the wall, and a downstream masonry inclined impervious floor sloping down from the crest of the wall to the stream bed and continued with riprap or paving. The crest of the wall is often equipped with collapsible shutters; (3) those which have a flat triangular profile similar to the second class but built of loose rocks and a number of parallel cross walls, one of which is placed on the crest line and forms the crest. The upstream floor slopes up from the stream bed to the crest on a slope usually 1 on 3 or 1 on 4, and a downstream or rollerway floor sloping from the crest to the stream bed on a slope ranging from 1 on 10 to 1 on 15, de-



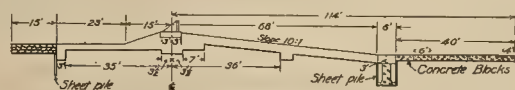
BURRA WEIR
INDIA

pending on the character of the stream bed. The Laguna weir is of this type, differing from the weirs in India, in that the walls are extended down below the stream bed. Sheet piling is used below the crest wall. In India the walls extend only down to the stream bed. This class of weir differs from the first or second class in that the apron is not impervious and therefore not subject to hydrostatic lift.

The first type of weir, modified often by shaping the downstream face of the weir, is the type most commonly used in the United States, and for this reason will be considered separately, although the general principles of design are applicable at least in part to the other types. The first type of weir consists of the superstructure or weir wall, the downstream impervious floor or apron with an extension of riprap or paving, a cut off wall or sheet piling at the upstream toe of the weir wall and at the lower end of the floor, and in some cases an upstream floor.

Forces acting on weir.

The forces acting on a diversion weir on pervious foundations include in addition to those acting on a weir built on an impervious foundation, the hydrostatic uplift and the underflow transportive or erosive force. The superstructure or weir wall which is supported on the impervious floor and built with it, is designed to resist the maximum resultant pressure in the same manner as if founded on an impervious bed. The design of the other parts of the weir are determined by the hydrostatic uplift and the underflow erosive force. The hydrostatic uplift is due to the difference in elevation between the water levels



JAMRAO WEIR
INDIA

on the upstream side and downstream side of the weir. The underflow erosive force depends on the velocity of the undercurrent which for any material will be directly proportional to the difference in elevation of the water levels and inversely proportional to the length of the path of percolation. The important principles of design of weirs on sand foundation are: (1) the floor must be designed of sufficient thickness to resist the uplift; (2) the path of percolation under the weir must be made large enough to offer sufficient resistance to the underflow to prevent the undermining of the structure.

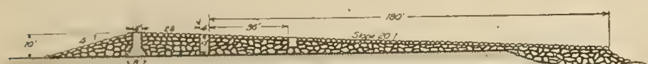
Hydrostatic uplift pressure.

A consideration of the principles of underflow is necessary to understand the principle of design. As stated above, the hydrostatic uplift is due to the difference in elevation between the water surfaces on both sides of the weir. The maximum uplift will occur when the difference in elevation is greatest, which is when the flow is minimum. For streams of low minimum flow or where the low flow is entirely diverted through the headgates, the maximum uplift will be obtained when the water level on the upstream side is level with the crest and when the stream below is dry or when the depth of tail water a minimum. The intensity of pressure is a maximum at the upper end of the path of percolation and is equal to the head producing the underflow. From this point the intensity of pressure diminishes in proportion to the length the water has to creep and is zero at the lower end of the path of percolation. The principle is similar to that of a horizontal pipe filled with sand and equal in length to the length of the path of percolation, connected at one end to a reservoir at a depth below the water surface equal to the head represented by the difference in elevation between the water surfaces on both sides of the dam, and with the other end discharging freely into air.

The intensity of pressure at any point along this line is represented by the head measured from this point to the hydraulic grade line.

Path of percolation.

From experiments made in India it has been found that in considering the uplift pressure the path of percolation is not the shortest line between the inlet and outlet, but the path formed by the surface of contact between the material of the stream bed and the different parts of the foundation of the weir, so that if water-tight cut-off walls or sheet piling be used, both at the upper toe of the weir and at the lower end of the floor, and placed not closer to each other than twice their depth, the path of percolation will be down the upstream face of the wall and up along its downstream face, then along



OKHLA WEIR
JUMNA RIVER, INDIA

the floor in between and down and up the second cut off wall. The effect, therefore, of using cut off walls is to increase the length of the path of percolation by twice the depth of earth wall. While the effect of the cut off wall at the upper toe of the weir is to decrease the uplift on the floor, the effect of the lower cut off wall is to increase the uplift. The same effect obtained with the upper cut off wall can be produced by constructing an impervious floor on the upstream side of the weir, equal in length to twice the depth of the sheet piling. This upstream floor may be thin because the depth of water on the floor will more than balance the upward pressure on the under side of the floor. The main purpose of the lower cut off wall is to either give a sufficient length of enforced percolation, or to protect the lower end of the floor from undermining. If a sufficient length of enforced percolation can be obtained without the lower cut off wall, drain holes through the wall or at the lower end of the wall are advisable to decrease the uplift.

Length of path of percolation.

The path of percolation must be great enough to offer sufficient resistance to the underflow to prevent the undermining of the structure by the transportation or washing away of the material under the floor. The necessary length of enforced percolation is expressed by Bligh by the following equation:

$$l = C \times H$$

where l = length or path of enforced percolation.

H = head of water represented by maximum difference of elevation of water levels on the upstream and downstream side of the weir.

C = coefficient depending on the character of the material. Bligh recommends the following values of C:

$C = 18$ for river beds of light silt and mud, as the Nile.

$C = 15$ for fine micaceous sand such as the Colorado River.

$C = 12$ for coarse grained sand.

$C = 9\text{-}5$ for boulders or shingle and gravel and sand mixed.

Intensity of uplift pressure and thickness and weight of floor.

The intensity of uplift pressure as previously considered, is the resultant of the upward pressure on the underface of the floor and the downward pressure due to the weight of the water on the upper face of the floor. The intensity of the resultant pressure head at the upper or inlet end of the path of percolation is equal to the head which produces the underflow, which is equal to the difference in elevation between the water levels on both sides of the weir. From this value (denoted by H) the intensity decreases along the path of percolation, and has a minimum value of zero at the outlet end of the path of percolation. The intensity of resultant uplift pressure at any point on the under face of the floor or at any point on the path of percolation is equal to $H - h$, where h represents the loss in head due to length of percolation to this point.

If l = total length of path of percolation.

l_1 = length of path of percolation to point considered.

p = intensity of resultant of uplift pressure in lbs. per square foot.

C = coefficient on which length of percolation path is based.

w_1 = weight of a cubic foot of water.

w_2 = weight of a cubic foot of floor material.

t = thickness of floor necessary to balance uplift.

Then $p = (H - h)w_1$; But $H/h = l/l_1$ and $l = HC$

$$\text{therefore, } h = \frac{Hl_1}{l} = \frac{Hl_1}{HC} = \frac{l_1}{C} \text{ and } p = \left(H - \frac{l_1}{C}\right)w_1$$

To balance the resultant uplift pressure the weight of the floor per square foot must at least equal the intensity of uplift pressure at this point; therefore,

$$w_2 t = H - \frac{l_1}{C} w_1 \text{ or } t = \left(H - \frac{l_1}{C}\right)\frac{W_1}{w_2} = \left(H - \frac{l_1}{C}\right)\frac{62.5}{w_2}$$

w_2 is the weight of the floor material, weighed in air, only when the surface of the tail water is lower than the under face of the floor. When the tail water covers the upper face of the floor, then the floor is submerged and w_2 must be the weight of the floor material weighed in water. When the surface of the tail water is at an elevation in between the under floor face and the upper floor face there is partial submergence only. For safety the thickness should be made about 1/3 greater than that required for exact balance; the equation is then:

$$t = \frac{4}{3}\left(H - \frac{l_1}{C}\right)\frac{62.5}{w_2} \quad \text{When floor is not submerged.}$$

$$t = \frac{4}{3}\left(H - \frac{l_1}{C}\right)\frac{62.5}{w_2 - 62.5} \quad \text{When floor is submerged.}$$

The minimum thickness of floor should not be less than 3 ft.

Length of floor and cut off walls.

The total length of the path of percolation is obtained as previously stated. This total length is divided up between the downstream floor, the cut off walls and in some cases an upstream floor. What proportion of it will go into the downstream floor itself depends on the impact of the falling water. Usually a length of floor, measured from the downstream toe of the weir wall, of 3 or 4 times the height of the weir crest above the floor, is sufficient. Mr. Bligh recommends the following empirical equation: Length of apron measured from downstream toe of weir wall = where C is the coefficient above referred to ranging

from 18 to 5 for different materials. H_a = height of weir crest above the floor. Knowing the length of the floor this value subtracted from the total length of percolation, gives the length to be provided for by cut off walls or upstream floor.

Length of riprap.

The impervious floor is continued with riprap or paving. The length of this riprap depends on the character of the stream bed, the height of fall and the volume of water carried. Mr. Bligh recommends the following formula to obtain the total length of floor and riprap.

Where H_b = the height of the weir crest above low water level on downstream side of weir wall.

9 = maximum flood discharge in cubic feet per second for lineal foot of weir crest.

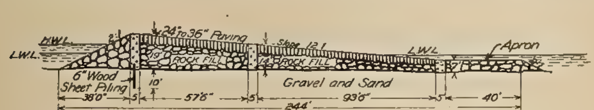
Therefore, the length of riprap will be $L_p = L - L_a = .355\ C \sqrt{H_b 9} - L_a$

The thickness of the riprap should not usually be less than two feet.

Preparation of foundations for weirs built on pervious soils such as sand, gravel, cobbles, etc.

The preparation of the foundation will depend on the type of weir. For this purpose they may be put in two classes: (1) the weirs which have a heavy floor and depend on their weight for their stability against upward pressure; (2) the weirs which have a light floor of lumber or reinforced concrete which must be held down to resist the upward pressure.

Weirs of the first class are constructed according to the principles considered for the design of gravity



LAGUNA WEIR

floor and require no special preparation of the foundation, except a cut off wall at the upstream toe of the weir to increase the path of percolation and in some cases a cut-off wall at the downstream end of the floor to obstruct any movement of the bed under the floor and prevent undermining by underwash. Steel sheet piling or wooden sheet piling made of three thicknesses of lumber so as to form tongue and groove joints are generally used. Where sheet piling can not be driven because of cobbles or boulders, it may be necessary to excavate deep trenches and build concrete cut off walls or wooden apron embedded in concrete.

The second class of weirs requires rows of piles driven in the sand and connected to the weir superstructure and floor and cut off walls. The entire bearing surface is prepared with rows of piles 4 to 8 ft. apart. When the superstructure and floor is to be made of lumber the rows of piles are connected together with cross timbers which will form part of the structure. When reinforced concrete is used the steel reinforcement of the floor must be connected to the piles and cut off walls which should be preferably reinforced concrete piles and sheet piles. The depth of penetration of the piles will depend on the upward lift, and should be sufficient to offer enough friction resistance to overcome the uplift on the floor.

References:

1. Dams on Sand Foundations, by Arnold C. Koenig, Transactions of the American Society of Civil Engineers, Sept., 1911.
2. Weir Experiments, Coefficients, and Formulas, by Robert E. Horton, Water Supply and Irrigation Papers, No. 150, U. S. Geological Survey.
3. The Practical Design of Irrigation Works, by W. G. Bligh. Van Nostrand Co., New York, 1911.

CONTRACTS AWARDED AT THE PANAMA-PACIFIC EXPOSITION.

The Buildings and Grounds Committee of the Panama-Pacific International Exposition, in a report just submitted to the board of directors, states that work in that department is progressing with great rapidity. The contract for filling Presidio lands will be completed by the Standard American Dredging Company within the next ten days. The construction of the Service Building will be completed before the first of February. The contract for the improvement of Fulton basin by the construction of docks, etc., has been awarded to Mercer, Fraser and Company. About one-half of the piles have been driven and caps for the wharves are being placed thereon. Contract for the construction of a roadway through Fort Mason is completed with the exception of the surfacing of the asphalt surface, which will be laid as soon as the weather permits, it being necessary to have dry weather to successfully lay asphalt. The contract for the construction of the South Garden sewers, awarded to Pringle, Dunn & Company, has been practically completed, as is also the grading of the site of the Machinery Building. Bids for the construction of the high pressure water system were received on January 28th. A contract for the construction of the sanitary and storm sewers in the State and Foreign Pavilion sites has been awarded to Michael Murphy for $28,350, and the contract will be signed within the next few days. The contract awarded to Palmer, McBride & Quayle for the preparation of gardens and courts is well under way and will probably be completed within the next ten days. The contract for the construction of Machinery Hall has been awarded to W. W. Anderson & Company, the contract price being $451,900. Bids have been received for the construction of the service water supply system, for the construction of the ferry slips and for the construction of a hydraulic power plant. Plans and specifications for the Educational Building are prepared and estimate of cost is being made. Contracts for the lumber for the Machinery Building, aggregating six and one-half million feet have been let at a cost of $113,000. Bids for the construction of steel apron and for ferry slips have been received.

ELECTRIC OPERATIONS IN SIAM.

At the recent half-yearly meeting of the Siam Electricity Co. (Ltd.) the manager reported that the new three-phase plant had been completed; that the new turbines were running regularly, and that the station is now equipped with an up-to-date and economical generating plant of ample capacity. The lighting business has increased 44 per cent during the last two years. The usual dividend of 6 per cent was declared the first half year of 1912.

TRANSFORMER CONNECTIONS[1]

BY W. A. HILLEBRAND AND E. R. SHEPARD.

With the extension and unification of power transmission systems a company frequently finds it necessary to furnish a miscellaneous service, single, two and three phase, 110, 220, 440, 550, 1100 and 2200 volts, applied to motors, and sometimes of more than one frequency. Distribution voltages, depending on distance and connected load, range from 1100 to 20,000.

To improve service on an overload feeder, it is, in general, cheaper to raise the voltage than to increase the amount of feeder copper, where the former can be accomplished without replacing existing equipment. In long-established territory it is often impracticable to adopt either two or three phases as standard or a limited range of secondary voltages, because of the amount of apparatus which the company would be obliged to replace at its own expense. These facts, together with the exigencies of reconstruction, temporary work and development of new territory, are often responsible for a resort to expedients, particularly in the way of transformer connections, which under ideal conditions might not be considered.

Accordingly, the present paper has been written for the purpose of collecting a number of the more important single and polyphase transformer diagrams and discussing the losses, regulation, and division of loads, in the hope that such a compendium may be of interest and value to the distribution engineer. Some of the material herein contained, which is printed for the sake of completeness, is common knowledge, readily available in hand-books and elsewhere, and still more is to be found in scattered articles throughout the literature, an incomplete list of which will be found at the end.

Fig. 1 illustrates the not infrequent practice in city distribution of paralleling two or more transformers at different points on a common secondary

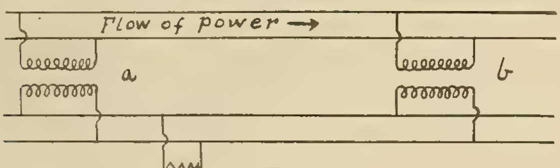


Fig. 1.

bus. Assuming the load concentrated at one point, the division of current can very readily be determined as follows:

r_p resistance of primary circuit, a to b.
x_p reactance of primary circuit, a to b.
r_a' primary resistance, transformer a.
r_a'' secondary resistance, transformer a.
x_a reactance, transformer a, measured on primary side.
r_s' resistance secondary bus, a to load.
x_s' reactance secondary bus, a to load.
r_b' primary resistance, transformer b.
r_b'' secondary resistance, transformer b.
x_b reactance, transformer b, measured on primary side.
r_s'' resistance of secondary bus, b to load.
x_s'' reactance of secondary bus, b to load.
n ratio of transformation.

There are two parallel circuits, one through transformer a to load, and the other through transformer b to load. Call these circuits A and B. Then, in terms of primary,

Resistance of circuit A $= R_a = r_a' + n^2 (r_a'' + r_s')$
Reactance of circuit A $= X_a = x_a + n^2 x_s^1$
Impedance of circuit A $= R_a + jX_a$
Resistance of B $= R_b' = r_p + r_b^1 + n^2 (r_b'' + r_s'')$
Reactance of B $= X_b = x_p + x_b + n^2 x_s''$
Impedance of B $= R_b + jX$

The impedance of the parallel circuit is

$$Z = \frac{(R_a + jX_a)\ (R_b + jX_b)}{(R_a + R_b) + j\,(X_a + X_b)}$$

If the load draws a current I in the primary, the impedance drop will be

$$e = ZI = \frac{(R_a + jX_a)\ (R_b + jX_b)}{(R_a + R_b) + j\,(X_a + X_b)}.I$$

The current in branch A is

$$i_a = \frac{e}{R_a + jX_a}$$

and in branch B

$$i_b = \frac{e}{R_b + jX_b}$$

These two currents will bear to each other the inverse ratio of their impedances. That is

$$\frac{i_a}{i_b} = \frac{R_b + jX_b}{R_a + jX_a}$$

and their arithmetic sum will not equal the total current I, but will in general be greater, due to the usually different power factors of the two circuits A and B. The vector representation is given in Fig. 2.

The excessive currents due to different power factors of the two branches become appreciable only when the ratio of resistance to reactance in one circuit is very high, and in the other very low. This might occur with load concentrated at a or b, in either of which cases the effect due to phase difference would

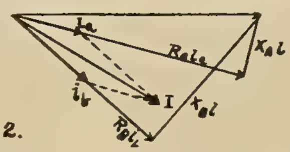


Fig. 2.

be swamped by the overloading due to disproportion in the impedance ratios, caused chiefly by the impedance of secondary bus. For this reason the question of phase displacement between the two branch currents is believed to be of only theoretical importance.

Use of the transformers, i. e., potential transformesr, with primaries connected in series across a potential too high for either alone.

Secondaries must be loaded as in Figs. 3 or 4. Loading as in Fig. 5 is not permissible, because the current drawn by the primary of transformer No. 1 must also pass through the primary of No. 2, which, having no neutralizing secondary ampere turns, now acts as a choke coil so that voltage across No. 1 will drop and correspondingly rise across No. 2.

An understanding of the behavior of transformers

[1]Paper presented before the Portland Section, A. I. E. E., January, 1913.

connected as in Fig. 5 and in open delta is of importance in appreciating the regulation and distribution of currents by the poly-phase connections which are subsequently discussed.

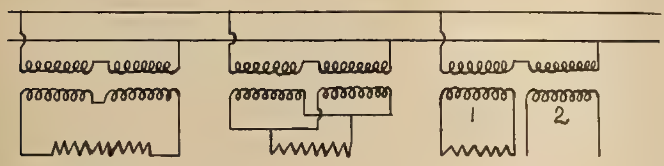


Fig. 3. Fig. 4 Fig. 5.

Open Delta.

With balanced, non-inductive load, the current in one transformer leads by 30 degrees, and the current in the other transformer lags by the same amount. Therefore, the combined capacity, based on temperature rise, is only 87 per cent of their combined capacity as single phase apparatus.

Due to the different power factors at which the two transformers operate they will regulate differently under load, that which carries the leading or high-power factor current suffering a smaller voltage drop than the other, with the result that voltages will unbalanced somewhat under load, although if the load itself is symmetrical, this unbalancing is not likely to be serious.

If single phase lighting is to be supplied, it should be connected as in Figs. 7 or 8, not as in Fig. 9.

When connected as in Fig. 9 both transformers must supply the single phase current, although one could do it equally as well with but half the loss. An additional objection to this connection arises from the fact that this single phase current leads the e.m.f. of one transformer by 60 degrees and lags behind that of the other by 60 degrees. These low power factor currents tend to aggravate the unbalancing at a time

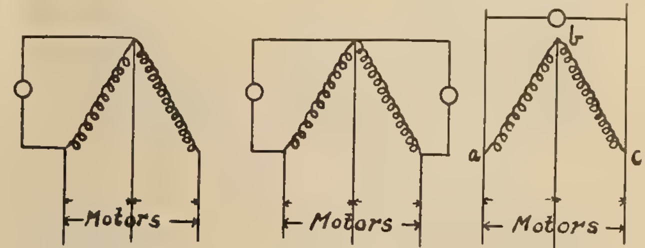


Fig. 7. Fig. 8. Fig. 9.

when the transformers can probably least stand the additional currents drawn as a result therefrom by induction motors.

The practice is occasionally met with of distributing four-wire, three-phase, at 4000 or 11,000 volts, using 2200 or 6600-volt transformers, primaries Y connected and neutrals grounded. The transformers are cheaper than if built for line voltage, and the 4000-volt system with only 2300 volts to ground, can be worked hot. If one transformer fails, service can still be maintained by two transformers up to 57 per cent of the capacity of all three. However, if the ground connection rusts away or dries out, the high resistance drop will cause such voltage distortion under load as to leave motors inoperative. This difficulty is eliminated by stringing a fourth or neutral conductor, which may be satisfactorily grounded at water courses.

(To be continued.)

READINESS TO SERVE METHODS

RECLAIMED LANDS.

BY ROSS B. MATEER.

Not all the lands now yielding large returns per acre cultivated, were developed merely by the use of water for encouraging vegetation as much of the soil now commanding high prices in the Sacramento Valley was, only a few years ago, subject to overflow during periods of high water and possessed characteristics of a marsh during other portions of the year. This land may be classed under two divisions: (1) the lowlands; (2) the peat islands.

The first class includes those lands contiguous to the natural streams subject annually to overflow during periods when the snow is rapidly melting in the mountains, the fertility of which is dependent on the deposits of sand, silt, clay or gravel made possible by the gradual disintegration of rock.

Lands of this character yield a good return per acre where artificial means are used to control the flood and direct its path.

The second class, on the other hand, includes those lands affected by tidewater known as "tule" and the peat bogs, both of unsurpassed fertility when yielding to cultivation.

Soils of this character must be protected from flood and tide. This necessitates the construction of embankments, principally of sand, though often with clay or concrete cores. Quantities of material, gravel and clay, can only be deposited in the periods of low water. Hence, huge steam and electrically operated dredges are utilized twenty hours each day, throughout the long summer months, to build embankments some fifty feet in width at the base, twenty-four feet wide at the top and from twenty to thirty feet high, which, as a rule, surround a tract of from 400 to 11,000 acres.

These undertakings, beyond the reach of any one individual, are accomplished only by the formation of reclamation districts in which each land owner submits to an assessment per acre for purposes of providing funds to meet the interest and per cent of principal due annually on the bonds issued by the district, and comprising a prior lien on all land embraced within the huge earthen breastworks. The principal and interest of all bonds are guaranteed by the county.

Reclamation Pumps.

To prevent the rapid rise in water level within the reclaimed districts through seepage and flood, motor operated pumps, varying from 12-inch up to and including 48-inch diameter, are installed, each belted to motors of sufficient capacity to operate against a maximum head.

Size of Pump	Average Capacity Gal. per Min.	Max. Head Total Ft.	Rev. per Minute	Size of Motor H.P.	Direct from Pumps, Acres Irrigated in One Hour, 1' Deep	2' Deep	3' Deep	4' Deep	6' Deep	8' Deep	Acres Irrigated in Twelve Hours, 1' Deep	2' Deep	3' Deep	4' Deep	6' Deep	8' Deep	Acres Irrigated in Twenty Four Hours, 1' Deep	2' Deep	3' Deep	4' Deep	6' Deep	8' Deep	Size of Reservoir, Size in Acres	Length Width Depth	Capacity in Gallons	Time Required to Fill	From Reservoir, Acres Irrigated in One Hour, 1' Deep	2' Deep	3' Deep	4' Deep	6' Deep	8' Deep	Acres Irrigated in Ten Hours, 1' Deep	2' Deep	3' Deep	4' Deep	6' Deep	8' Deep
1	20	20	1740	½	.0305	.015	.010	.0076	.005	.0038	.366	.183	.122	.0915	.061	.0457	.732	.366	.244	.183	.122	.0914	.01	21X21X4'	28800	24 Hours	.073	.036	.024	.018	.012	.009	.73	.36	.24	.18	.12	.09
1	20	45	1740	1	.0305	.015	.010	.0076	.005	.0038	.366	.183	.122	.0915	.061	.0457	.732	.366	.244	.183	.122	.0914	.01	21X21X4'	28800	24	.073	.036	.024	.018	.012	.009	.73	.36	.24	.18	.12	.09
1	20	60	1740	2	.0305	.015	.010	.0076	.005	.0038	.366	.183	.122	.0915	.061	.0457	.732	.366	.244	.183	.122	.0914	.01	21X21X4'	28800	24	.073	.036	.024	.018	.012	.009	.73	.36	.24	.18	.12	.09
1½	50	20	1740	1	.074	.037	.024	.0185	.012	.009	.89	.445	.293	.223	.148	.11	1.78	.89	.586	.445	.296	.22	.055	50X50X4'	72,000	24	.177	.089	.0576	.045	.027	.022	1.77	.89	.576	.45	.27	.22
1½	50	45	1740	2	.074	.037	.024	.0185	.012	.009	.89	.445	.293	.223	.148	.11	1.78	.89	.586	.445	.296	.22	.055	50X50X4	72,000	24	.177	.089	.0576	.045	.027	.022	1.77	.89	.576	.45	.27	.22
1½	50	60	1740	3	.074	.037	.024	.0185	.012	.009	.89	.445	.293	.223	.148	.11	1.78	.89	.586	.445	.296	.22	.055	50X50X4	72,000	24	.177	.089	.0576	.045	.027	.022	1.77	.89	.576	.45	.27	.22
2	100	20	1740	2	.15	.075	.05	.037	.025	.0183	1.80	.90	.60	.45	.30	.225	3.60	1.80	1.20	.90	.60	.45	.11	70X70X4	144000	24	.36	.18	.12	.09	.06	.044	3.60	1.80	1.20	.89	.60	.44
2	100	45	1740	3	.15	.075	.05	.037	.025	.0183	1.80	.90	.60	.45	.30	.225	3.60	1.80	1.20	.90	.60	.45	.11	70X70X4	144000	24	.36	.18	.12	.09	.06	.044	3.60	1.80	1.20	.89	.60	.44
2	100	60	1740	5	.15	.075	.05	.037	.025	.0183	1.80	.90	.60	.45	.30	.225	3.60	1.80	1.20	.90	.60	.45	.11	70X70X4	144000	24	.36	.18	.12	.09	.06	.044	3.60	1.80	1.20	.89	.60	.44
2½	150	20	1120	2	.225	.112	.075	.056	.037	.028	2.70	1.35	.90	.675	.45	.337	5.4	2.70	1.80	1.35	.90	.674	.17	85X85X4	216000	24	.54	.27	.18	.135	.09	.067	5.4	2.7	1.8	1.35	.90	.67
2½	150	35	1120	3	.225	.112	.075	.056	.037	.028	2.70	1.35	.90	.675	.45	.337	5.4	2.70	1.80	1.35	.90	.674	.17	85X85X4	216000	24	.54	.27	.18	.135	.09	.067	5.4	2.7	1.8	1.35	.90	.67
2½	150	50	1740	5	.225	.112	.075	.056	.037	.028	2.70	1.35	.90	.675	.45	.337	5.4	2.70	1.80	1.35	.90	.674	.17	85X85X4	216000	24	.54	.27	.18	.135	.09	.067	5.4	2.7	1.8	1.35	.90	.67
2½	150	60	1740	5	.225	.112	.075	.056	.037	.028	2.70	1.35	.90	.675	.45	.337	5.4	2.70	1.80	1.35	.90	.674	.17	85X85X4	216000	24	.54	.27	.18	.135	.09	.067	5.4	2.7	1.8	1.35	.90	.67
2½	150	75	1740	7½	.225	.112	.075	.056	.037	.028	2.70	1.35	.90	.675	.45	.337	5.4	2.70	1.80	1.35	.90	.674	.17	85X85X4	216000	24	.54	.27	.18	.135	.09	.067	5.4	2.7	1.8	1.35	.90	.67
3	225	20	850	3	.34	.17	.113	.085	.056	.042	4.08	2.04	1.36	1.02	.68	.51	8.16	4.08	2.72	2.04	1.36	1.11	.23	104X104X4	324000	24	.815	.41	.27	.20	.18	.10	8.15	4.10	2.7	2.0	1.8	1.0
3	225	35	1120	5	.34	.17	.113	.085	.056	.042	4.08	2.04	1.36	1.02	.68	.51	8.16	4.08	2.72	2.04	1.36	1.11	.23	104X104X4	324000	24	.815	.41	.27	.20	.18	.10	8.15	4.10	2.7	2.0	1.8	1.0
3	225	50	1740	7½	.34	.17	.113	.085	.056	.042	4.08	2.04	1.36	1.02	.68	.51	8.16	4.08	2.72	2.04	1.36	1.11	.23	104X104X4	324000	24	.815	.41	.27	.20	.18	.10	8.15	4.10	2.7	2.0	1.8	1.0
3	225	60	1740	7½	.34	.17	.113	.085	.056	.042	4.08	2.04	1.36	1.02	.68	.51	8.16	4.08	2.72	2.04	1.36	1.11	.23	104X104X4	324000	24	.815	.41	.27	.20	.18	.10	8.15	4.10	2.7	2.0	1.8	1.0
3	225	75	1740	10	.34	.17	.113	.085	.056	.042	4.08	2.04	1.36	1.02	.68	.51	8.16	4.08	2.72	2.04	1.36	1.11	.23	104X104X4	324000	24	.815	.41	.27	.20	.18	.10	8.15	4.10	2.7	2.0	1.8	1.0
3½	300	20	850	5	.44	.22	.146	.11	.073	.055	5.37	2.69	1.79	1.35	.898	.673	10.78	5.38	3.58	2.70	1.80	1.34	.33	121X121X4	432000	24	1.05	.53	.35	.26	.17	.13	10.5	5.3	3.5	2.6	1.7	1.3
3½	300	35	1120	7½	.44	.22	.146	.11	.073	.055	5.39	2.69	1.79	1.35	.898	.673	10.78	5.38	3.58	2.70	1.80	1.34	.33	121X121X4	432000	24	1.05	.53	.35	.26	.17	.13	10.5	5.3	3.5	2.6	1.7	1.3
3½	300	50	1740	10	.44	.22	.146	.11	.073	.055	5.39	2.69	1.79	1.35	.898	.673	10.78	5.38	3.58	2.70	1.80	1.34	.33	121X121X4	432000	24	1.05	.53	.35	.26	.17	.13	10.5	5.3	3.5	2.6	1.7	1.3
3½	300	60	1740	10	.44	.22	.146	.11	.073	.055	5.39	2.69	1.79	1.35	.898	.673	10.78	5.38	3.58	2.70	1.80	1.34	.33	121X121X4	432000	24	1.05	.53	.35	.26	.17	.13	10.5	5.3	3.5	2.6	1.7	1.3
3½	300	75	1740	15	.44	.22	.146	.11	.073	.055	5.39	2.69	1.79	1.35	.898	.673	10.78	5.38	3.58	2.70	1.80	1.34	.33	121X121X4	432000	24	1.05	.53	.35	.26	.17	.13	10.5	5.3	3.5	2.6	1.7	1.3
4	400	20	850	5	.61	.305	.20	.15	.10	.075	7.35	3.67	2.45	1.84	1.225	.92	14.70	7.34	4.90	3.68	2.45	1.84	.44	139X139X4	576000	24	1.46	.73	.48	.36	.24	.18	14.6	7.3	4.8	3.6	2.4	1.8
4	400	35	1120	7½	.61	.305	.20	.15	.10	.075	7.35	3.67	2.45	1.84	1.225	.92	14.70	7.34	4.90	3.68	2.45	1.84	.44	139X139X4	576000	24	1.46	.73	.48	.36	.24	.18	14.6	7.3	4.8	3.6	2.4	1.8
4	400	50	1120	10	.61	.305	.20	.15	.10	.075	7.35	3.67	2.45	1.84	1.225	.92	14.70	7.34	4.90	3.68	2.45	1.84	.44	139X139X4	576000	24	1.46	.73	.48	.36	.24	.18	14.6	7.3	4.8	3.6	2.4	1.8
4	400	60	1120	15	.61	.305	.20	.15	.10	.075	7.35	3.67	2.45	1.84	1.225	.92	14.70	7.34	4.90	3.68	2.45	1.84	.44	139X139X4	576000	24	1.46	.73	.48	.36	.24	.18	14.6	7.3	4.8	3.6	2.4	1.8
4	400	75	1120	15	.61	.305	.20	.15	.10	.075	7.35	3.67	2.45	1.84	1.225	.92	14.70	7.34	4.90	3.68	2.45	1.84	.44	139X139X4	576000	24	1.46	.73	.48	.36	.24	.18	14.6	7.3	4.8	3.6	2.4	1.8
5	700	20	850	7½	1.08	.54	.36	.27	.18	.135	13.0	6.5	4.3	3.25	2.16	1.62	26.00	13.0	8.6	6.50	5.32	3.24	.77	184X184X4	1008000	24	2.6	1.3	.86	.65	.43	.32	26.4	13.0	8.6	6.5	4.3	3.2
5	600	35	1120	10	.92	.46	.306	.23	.153	.115	11.04	5.52	3.68	2.76	1.84	1.38	22.08	11.04	7.36	5.52	3.68	2.76	.66	170X170X4	864000	24	2.2	1.1	.73	.55	.36	.27	22.0	11.0	7.3	5.5	3.6	2.7
5	600	50	1120	15	.92	.46	.306	.23	.153	.115	11.04	5.52	3.68	2.76	1.84	1.38	22.08	11.04	7.36	5.52	3.68	2.76	.66	170X170X4	864000	24	2.2	1.1	.73	.55	.36	.27	22.0	11.0	7.3	5.5	3.6	2.7
5	700	60	1120	20	1.08	.54	.36	.27	.18	.135	13.0	6.5	4.3	3.25	2.16	1.62	26.0	13.0	8.6	6.50	5.32	3.24	.77	184X184X4	1008000	24	2.6	1.3	.86	.65	.43	.32	26.4	13.0	8.6	6.5	4.3	3.2
5	700	75	1120	25	1.08	.54	.36	.27	.18	.135	13.0	6.5	4.3	3.25	2.16	1.62	26.0	13.0	8.6	6.50	5.32	3.24	.77	184X184X4	1008000	24	2.6	1.3	.86	.65	.43	.32	26.4	13.0	8.6	6.5	4.3	3.2
6	900	20	850	10	1.36	.68	.486	.34	.243	.17	16.4	8.2	5.46	4.10	2.73	2.5	32.8	16.4	11.92	8.20	5.32	5.00	1.00	208X208X4	1296000	24	3.26	1.63	1.08	.81	.54	.40	32.6	16.3	10.8	8.10	5.4	4.0
6	900	35	1120	15	1.36	.68	.486	.34	.243	.17	16.4	8.2	5.46	4.10	2.73	2.5	32.8	16.4	11.92	8.20	5.32	4.10	1.00	208X208X4	1296000	24	3.26	1.63	1.08	.81	.54	.40	32.6	16.3	10.8	8.10	5.4	4.0
6	900	50	1120	20	1.36	.68	.486	.34	.243	.17	16.4	8.2	5.46	4.10	2.73	2.5	32.8	16.4	11.92	8.20	5.32	4.10	1.00	208X208X4	1296000	24	3.26	1.63	1.08	.81	.54	.40	32.6	16.3	10.8	8.10	5.4	4.0
6	900	60	1120	25	1.36	.68	.486	.34	.243	.17	16.4	8.2	5.46	4.10	2.73	2.5	32.8	16.4	11.92	8.20	5.96	4.10	1.00	208X208X4	1296000	24	3.26	1.63	1.08	.81	.54	.40	32.6	16.3	10.8	8.10	5.4	4.0
6	900	75	1120	35	1.36	.68	.486	.34	.243	.17	16.4	8.2	5.46	4.10	2.73	2.5	32.8	16.4	11.92	8.20	5.96	4.10	1.00	208X208X4	1296000	24	3.26	1.63	1.08	.81	.54	.40	32.6	16.3	10.8	8.10	5.4	4.0
7	1200	20	695	10	1.84	.92	.613	.46	.306	.23	22.08	11.04	7.36	5.52	3.68	2.76	44.16	22.08	14.72	11.04	6.76	5.52	1.32	240X240X4	1728000	24	4.41	2.2	1.47	1.10	.73	.55	44.1	22.0	14.7	11.0	7.3	5.5
7	1200	35	850	15	1.84	.92	.613	.46	.306	.23	22.08	11.04	7.36	5.52	3.68	2.76	44.16	22.08	14.72	11.04	6.76	5.52	1.32	240X240X4	1728000	24	4.41	2.2	1.47	1.10	.73	.55	44.1	22.0	14.7	11.0	7.3	5.5
7	1200	50	850	25	1.84	.92	.613	.46	.306	.23	22.08	11.04	7.36	5.52	3.68	2.76	44.16	22.08	14.72	11.04	6.76	5.52	1.32	240X240X4	1728000	24	4.41	2.2	1.47	1.10	.73	.55	44.1	22.0	14.7	11.0	7.3	5.5
7	1200	60	850	30	1.84	.92	.613	.46	.306	.23	22.08	11.04	7.36	5.52	3.68	2.76	44.16	22.08	14.72	11.04	6.76	5.52	1.32	240X240X4	1728000	24	4.41	2.2	1.47	1.10	.73	.55	44.1	22.0	14.7	11.0	7.3	5.5
7	1200	75	850	40	1.84	.92	.613	.46	.306	.23	22.08	11.04	7.36	5.52	3.68	2.76	44.16	22.08	14.72	11.04	6.76	5.52	1.32	240X240X4	1728000	24	4.41	2.2	1.47	1.10	.73	.55	44.1	22.0	14.7	11.0	7.3	5.5
8	1600	20	695	15	2.38	1.19	.76	.59	.38	.295	28.6	14.30	9.50	7.15	4.76	3.57	57.2	28.6	19.0	14.30	9.52	7.14	1.77	278X278X4	2304000	24	5.71	2.85	1.90	1.42	.95	.71	57.1	28.5	19.0	14.2	9.5	7.1
8	1600	35	695	20	2.38	1.19	.76	.59	.38	.295	28.6	14.30	9.50	7.15	4.76	3.57	57.2	28.6	19.0	14.30	9.52	7.14	1.77	278X278X4	2304000	24	5.71	2.85	1.90	1.42	.95	.71	57.1	28.5	19.0	14.2	9.5	7.1
8	1600	50	850	30	2.38	1.19	.76	.59	.38	.295	28.6	14.30	9.50	7.15	4.76	3.57	57.2	28.6	19.0	14.30	9.52	7.14	1.77	278X278X4	2304000	24	5.71	2.85	1.90	1.42	.95	.71	57.1	28.5	19.0	14.2	9.5	7.1
8	1600	60	850	40	2.38	1.19	.76	.59	.38	.295	28.6	14.30	9.50	7.15	4.76	3.57	57.2	28.6	19.0	14.30	9.52	7.14	1.77	278X278X4	2304000	24	5.71	2.85	1.90	1.42	.95	.71	57.1	28.5	19.0	14.2	9.5	7.1
8	1600	75	850	50	2.38	1.19	.76	.59	.38	.295	28.6	14.30	9.50	7.15	4.76	3.57	57.2	28.6	19.0	14.30	9.52	7.14	1.77	278X278X4	2304000	24	5.71	2.85	1.90	1.42	.95	.71	57.1	28.5	19.0	14.2	9.5	7.1
10	2500	20	565	20	3.78	1.89	1.26	.945	.63	.472	45.36	22.68	15.12	11.34	7.56	5.67	90.72	45.36	30.24	22.68	15.12	11.34	2.76	347X347X4	3600000	24	8.97	4.48	2.99	2.24	1.49	1.12	89.7	44.8	29.9	22.4	14.9	11.2
10	2500	35	695	30	3.78	1.89	1.26	.945	.63	.472	45.36	22.68	15.12	11.34	7.56	5.67	90.72	45.36	30.24	22.68	15.12	11.34	2.76	347X347X4	3600000	24	8.97	4.48	2.99	2.24	1.49	1.12	89.7	44.8	29.9	22.4	14.9	11.2
10	2500	50	695	50	3.78	1.89	1.26	.945	.63	.472	45.36	22.68	15.12	11.34	7.56	5.67	90.72	45.36	30.24	22.68	15.12	11.34	2.76	347X347X4	3600000	24	8.97	4.48	2.99	2.24	1.49	1.12	89.7	44.8	29.9	22.4	14.9	11.2
10	2500	60	695	60	3.78	1.89	1.26	.945	.63	.472	45.36	22.68	15.12	11.34	7.56	5.67	90.72	45.36	30.24	22.68	15.12	11.34	2.76	347X347X4	3600000	24	8.97	4.48	2.99	2.24	1.49	1.12	89.7	44.8	29.9	22.4	14.9	11.2
10	2500	75	850	75	3.78	1.89	1.26	.945	.63	.472	45.36	22.68	15.12	11.34	7.56	5.67	90.72	45.36	30.24	22.68	15.12	11.34	2.76	347X347X4	3600000	24	8.97	4.48	2.99	2.24	1.49	1.12	89.7	44.8	29.9	22.4	14.9	11.2
12	3500	20	565	25	5.28	2.64	1.76	1.32	.88	.66	63.4	31.71	21.14	15.85	10.57	7.82	126.8	62.4	42.28	31.7	21.14	15.64	3.85	410X410X4	5040000	24	12.67	6.33	4.22	3.16	2.11	1.58	126.7	63.3	42.2	31.6	21.1	15.8
12	3500	33	565	50	5.28	2.64	1.76	1.32	.88	.66	63.4	31.71	21.14	15.85	10.57	7.82	126.8	62.4	42.28	31.7	21.14	15.64	3.85	410X410X4	5040000	24	12.67	6.33	4.22	3.16	2.11	1.58	126.7	63.3	42.2	31.6	21.1	15.8
12	3500	50	695	60	5.28	2.64	1.76	1.32	.88	.66	63.4	31.71	21.14	15.85	10.57	7.82	126.8	62.4	42.28	31.7	21.14	15.64	3.85	410X410X4	5040000	24	12.67	6.33	4.22	3.16	2.11	1.58	126.7	63.3	42.2	31.6	21.1	15.8
12	3500	60	695	75	5.28	2.64	1.76	1.32	.88	.66	63.4	31.71	21.14	15.85	10.57	7.82	126.8	62.4	42.28	31.7	21.14	15.64	3.85	410X410X4	5040000	24	12.67	6.33	4.22	3.16	2.11	1.58	126.7	63.3	42.2	31.6	21.1	15.8
12	3500	75	850	100	5.28	2.64	1.76	1.32	.88	.66	63.4	31.71	21.14	15.85	10.57	7.82	126.8	62.4	42.28	31.7	21.14	15.64	3.85	410X410X4	5040000	24	12.67	6.33	4.22	3.16	2.11	1.58	126.7	63.3	42.2	31.6	21.1	15.8

NOTE—CAPACITY OF RESERVOIR EQUALS 24 TIMES SAME PUMP CAPACITY DISCHARGING DIRECT INTO THE DITCHES. PUMP DISCHARGING INTO RESERVOIR CONTINUOUSLY FOR 24 HOURS.

Table of Irrigation Data Showing 70% of Theoretical Quantity to Allow for Losses. — Compiled by United Iron Works.

The land is provided with ditches which drain to a low spot or sump, in which, is placed the suction pipe of the pump.

From the sump, the water is elevated over the levee and discharged into the slough or drain ditch which parallels the levee.

Operating Cost.

Operating costs vary with seepage conditions. Where only floods are to be feared, the installations are from 75 to 100 h.-p., and the annual cost, except in extreme wet weather, will not exceed $900 to $1,200 where motor-drive is used, or $1,500 to $2,250 where oil is used as fuel, and reciprocating engine type units employed to operate the pumps.

Ditches Drain to a Sump, From Which the Water Is Elevated Over the Levee.

The expenses of such equipments include those of an engineer, a fireman, fuel and items incident to repairs, aggregating from $15.00 to $18.00 per annum on installations of 100 h.-p.

Recent activity on the part of power companies has resulted in many motor-operated equipments supplanting the steam apparatus, not alone by reason of decreased annual expense, but also by reason of flexibility in pumping units, combined with the simplicity of operation not possessed by other forms of power.

A recent change affected one of the oldest reclamation plants in point of service. The original installation consisting of a 26-inch Byron Jackson Centrifugal pump, coupled to an engine of 125 h.-p., was replaced with two pumps, each of 12-inch diameter, and a capacity of 4,500 gallons per minute, belted to motors of 75 h.-p., 2,000 volts, polyphase type.

Under ordinary conditions, one pump, operating 24 hours a day in wet seasons, will suffice to prevent overflow on the 420 acres comprising the district. The second pump constitutes reserve which increases the pumping capacity to 9,000 gallons per minute, under a head of 22 feet, should accident to the levee result in a rapid inrush of water. The installation of the new pumping plant, complete, will not exceed $4,500, or an assessment of $11.25 per acre, with an estimated maximum operating expense, based on previous years pumping, of $900, or $2.25 per acre, compared with the expense of $3.75 with steam. An economy of $1.50 per acre.

Comparison of operating expenses per h.-p. installed, show that the cost of steam equipment ranges from $15 to $18, while that of motor operated pumps, gives an average in this case of $6 per h.-p., or an economy of from $9 to $12 per annum, per h.-p. installed, over that of steam operated pumps.

Analysis of the operating costs, indicate that much of the saving is the result of fuel economy, labor and miscellaneous expense.

The motor may be placed in service by the throwing of a switch, and requires a minimum of attendance throughout the period of operation. The expense ceases where the water is below the ground level—eliminating standby steam losses and attendance. Proper design and fewer moving parts minimize the expense incident to repairs.

Many thousand acres, ranging in value from $250 to $800 per acre, and yielding abundant crops of fruit and alfalfa, are today under cultivation in the tule and peat islands of the Sacramento River, as a result of the motor-operated reclamation equipments used to throw excess seepage and flood waters over the protecting levee into the slough.

CONSULTING ENGINEERS COMPLAIN OF NEW YORK PUBLIC SERVICE COMMISSION.

The American Institute of Consulting Engineers has issued a circular giving the text of a letter to the Governor of New York regarding the fact that no engineers are acting on the New York Public Service Commission. They urge the appointment of such Commissioners independent of political or other pressure, and secondly, to appoint men of engineering training selected from a list of, say, a dozen men to be submitted by the presidents of the five National engineering societies in co-operation with the presidents of the Chamber of Commerce and The Merchants' Association.

LEADING NATURAL PRODUCTS OF THE UNITED STATES.

PRODUCT	1902 Quantity	1902 Value	1911 Quantity	1911 Value
Fuels—				
Bituminous coal (j), short tons	260,216,844	$290,858,483	405,757,101	$451,177,484
Pennsylvania Anthracite, long tons	36,940,710	76,173,586	80,771,488	175,189,392
Natural gas	......	30,867,863	......	74,127,534
Petroleum, barrels (42 gallons)	88,766,916	71,178,910	220,449,391	134,044,752
Peat	......	......	......	272,114
Metals—				
Pig iron (a) (spot value b), long tons	17,821,307	372,775,000	23,257,288	327,334,624
Copper (e), value at New York City, pounds	659,508,644	76,568,954	1,097,232,749	137,154,092
Structural Materials—				
Clay products (k)	......	122,169,531	......	162,236,181
Cement, barrels (380 lbs. net)	25,753,504	25,366,380	79,547,958	66,705,136
Stone (1)	......	54,798,682	......	77,108,567

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue. Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.

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CONTENTS

The Order for Joint Service

Scarcely seventy years have passed since the first railroad bridge was thrown across the Alleghany River. This bridge brought together tracks from Philadelphia and Ohio. It brought them together but could not join them, for the Pennsylvania state legislature had decreed that their gauges be different, fearing that local rolling stock might wander out of sight and lose itself.

How vastly broadened has become the horizon of utility regulation within the life of but one man! During the past week, for instance, a noteworthy decision has been handed down by the California Railroad Commission. The commission virtually rules that not alone should broad gauge ideas be infused among competing carriers of freight and human burdens, but even in those utilities conveying the weightless tones of the human voice, the same ideas of public necessity must have full sway. In a word the commission holds that unrelated telephone companies have the right to call upon each other for the exchange of messages.

The case in question arose upon the complaint of the Tehama County Telephone Company and the Glenn County Telephone Company in Northern California against the Pacific Telephone Company. The complaining companies desired to connect with the Pacific, so as to enable their patrons to use the long distance service of the Pacific company. The Pacific company declined to afford the connection and hence the case was brought to the commission. As noted above the commission finds that public convenience requires that the physical connection be made and that the complaining companies should stand the expense. The commission finds further that the telephone companies should arrange for a just division among themselves of the rates, tolls and charges, and if unable to do so within twenty days the commission itself will act in the matter.

The entire controversy embodies a new departure in regulation. It is seen at once to have far-reaching ramifications. For instance, a power company serving a community, may, upon this same principle, be allowed to make a physical connection with its competitor even though it be done against the will of its competitor. Thus a struggling, single-plant central station operating within reach of a network of a competing company may at once derive the stability and continuity of service to be realized from synchronous physical connection. Such a possibility is not to be deplored, however, for it is truly founded on principles of equity and justice. Moreover, the great majority of such possibilities are even now taken advantage of by mutual consent of both parties to the issue throughout the West. When a scientific rate based upon costs of continuity of service is thereby charged for such power as may be used, the public benefits immeasurably and the utility companies suffer not at all. Indeed it is the inevitable law of utility growth that where continuity of service is assured the usefulness of the product of the utility becomes proportionately broadened.

To cite a concrete instance it is evident that if anyone residing in San Francisco formerly desired to speak with a party situated on the Tehama lines,

upon being told that a messenger would have to be called to deliver the service or that it would be necessary to transmit it to the party desired, the chances are strong that either the mails or the telegraph company would reap the fee. A broader instance is that of interchange of mails in foreign service. Long series of checking indicate that both parties benefit in about the same proportion.

Each day in the evolution of utility regulation broad gauge men come more and more to the realization that maximum service at minimum cost, like Portia's dream of mercy, "blesseth him that gives and him that takes." It is a thoroughly recognized principle among advanced thinkers that a utility company is entitled to a reasonable return on the legitimate costs of service, and that the public is in return entitled to the very best commodity the utility by any possible combination can furnish. The joint service order, then, should be accepted as a reasonable, rational, new departure in utility regulation.

The principle being a new and untried one, an injustice may possibly in this instance and indeed in other applications be brought to one or the other of the companies joining in such physical connection. The commission in its wisdom has provided that, if the companies themselves cannot agree upon a just division of the tolls, it will fix the rates. It is certainly due the companies at issue, that this matter be given the most scientific readjustment possible, in order that no undue advantage be given a competing company under such an order.

Reclamation of Submerged Lands

The dykes of Holland and the traditions which have grown up in that country since their formation are known the world over. The fertility of the soil there to be found is recognized as wholly accountable for the fact that in the Netherlands today exist more human souls to the square mile than in any other country on earth. Only in the last two or three years have agriculturists come to a realiaztion of the possible reduplication of this European feat upon a hitherto untouched empire in certain submerged portions of the West. The actual harvests gathered since the construction of the Laguna dam and the 73 miles of levees in the Colorado-Yuma project have indeed given emphasis to this possibility. The happy, smiling faces of contented families now dwelling upon lands in this reclamation project, where formerly human existence was impossible, forcefully add their evidence.

Each day brings to light similar possibilities in other parts of the West. Our leading article of this issue interestingly describes what is being accomplished at Isleton, situated in the heart of the delta of the Sacramento and San Joaquin rivers in the great central basin of California. The reclamation here taking place is of course interesting to all citizens of the West, for acreages by thousands are being brought from submerged tule lands to highly intensified farming possibilities. Since electric power is, however, largely responsible for this transformation, the subject is of especial interest to the hydroelectric fraternity.

In usual instances, irrigable lands take power only as a summer load. Here, however, it is found that in these countless reclaimed islands even the self-same pumps which operate to lift waters for irrigation are reversed in operation during a considerable portion of the remaining months of the year to keep the waters away from the flooded lands. In some cases where the lands are lower than the river waters power is not necessary to accomplish this reversal. Thus, at the Ryde plant during the summer months, when irrigation becomes necessary, the motor is disconnected, the discharge line is primed through a by-pass to the vacuum pump and water is then siphoned in from the river, as the pump runner is then forced to revolve freely in the reverse direction, thereby acting as a turbine.

Another interesting feature among the districts formed in these islands is the fact that, although as a rule the reclamation season lasts from December to April and the irrigation season from June to October, still in exceptional cases far different service is demanded. In 1911-12, for instance, no reclamation pumping was necessary at all, while in 1910-11 continuous operation was imperative. Indeed, the anomalous condition often exists of reclamation pumping and irrigation in simultaneous operation on different parts of an island.

Such varying calls for power have made the path of the electric power salesman much easier than he would otherwise find it, for although as yet operation by electric power is not quite as cheap as gas and steam power, still the elasticity and continuity of service afforded wins the load. The possibilities of combined reclamation and irrigation throughout various districts of the West, thus offer an ever broadening horizon for the consumption of electric power.

The Value of Natural Gas

The early entry of natural gas into the metropolitan district of Southern California as a competitor of manufactured oil gas and electrical energy, makes the subject one of timely interest. The tremendous growth of the crude petroleum output in California has been the marvel of all

As is often the case, however, certain by-products of an industry, at first unrecognized and unheralded, soon begin to rival the importance of the principal. Within the next few weeks natural gas is to be transmitted from Bakersfield into Los Angeles—a truly long distance transmission of heat energy. To those familiar with the awful waste of former days in Eastern natural gas fields, the lesson is an impressive one. When we consider the profligate manner in which milions of dollars in natural resources were lost forever to the uses of human endeavor, it would seem that Western industry is to be congratulated upon a far-sighted policy of utilizing this enormous natural by-product of the oil-fields. True conservation should lead every high-spirited citizen to lend all reasonable support to any undertaking which puts to a useful purpose unharnessed energies that otherwise go by the board never again to be replaced. In the case of the utilization of natural gas, however, something more than mere sentimental satisfaction is in sight. It is not generally known, but the fact is nevertheless true, that the value of natural gas produced in this country in 1911, for instance, foots up the enormous total of $74,127,534, as compared with $134,044,752 for crude petroleum.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Chas. W. Hobson, founder of the Jovian Order, is in San Francisco.

N. R. Stansel has returned to Douglass, Ariz., after a visit to San Francisco.

H. E. Grant, sales engineer with the Holophane Company, is at Los Angeles.

A. B. Saurman, of the Standard Underground Cable Co., is making a trip throughout the East.

W. W. Briggs, sales manager of Westinghouse Electric & Manufacturing Co., has left for a flying trip East.

R. D. Holabird, of the Holabird-Reynolds Electric Company, has returned to San Francisco from an extensive Eastern trip.

H. N. Lauritzen, Pacific Coast manager for the Holophane Company, has returned to his San Francisco offices after an extensive trip throughout the East.

J. A. Spears has resigned as sales engineer with the San Francisco office of the Holophane Company to join the illuminating department of H. W. Johns-Manville Company at San Francisco.

Richard S. Buck has retired from the firm of Sanderson & Porter and has become chief engineer of the Dominion Bridge Company of Canada. **Seton Porter** has been admitted as a member of the firm.

A. B. Domonoske has resigned his position as instructor in mechanical engineering at the University of California to accept a position in the mechanical engineering department at the University of Illinois.

Kirk Bryan of the U. S. Geological Survey has finished six months' investigation of the ground waters of the Sacramento Valley and left this week for Washington, D. C., where he will prepare a report of his investigations.

R. C. Dwyer, district manager of the Idaho Railway, Light & Power Co., at Caldwell, Idaho, has been transferred to the engineering department of the company at Boise. He is succeeded by **B. H. Wayne**, formerly connected with the Nampa office of the company. **L. D. Orr**, local manager of the Nampa office, will have general supervision of both the Caldwell and Nampa systems.

Marshall C. McKay has been appointed assistant electrical engineer of the Panama-Pacific International Expositon Company. Mr. McKay has had a wide experience in the construction and operation of Pacific Coast power plants and is peculiarly well qualified for his new duties. In accepting the position he has resigned as engineer in charge of construction and of operation in the generating and transmission system of the Sierra & San Francisco Power Company. The quarters of the electrical engineering department of the Exposition were moved to the Service Building on the grounds during the past week.

Lee Hargood, of the Lighting Department, General Electric Company, Schenectady, N. Y., delivered a lecture before the engineering students of Leland Stanford Jr. University on January 29th. The subject of Mr. Hargood's talk was "Automatic Voltage Control at the Receiving Points of Transmission Lines by Means of Synchronous Machinery." The application of the synchronous condenser controlled with a Tirrel Regulator was discussed in detail. An interesting feature was brought out in that it was shown that by automatically controlling the wattless current in transmission lines, constant voltage difference can be maintained between the generating and receiving ends. By using suitable synchronous condensers properly located, this voltage difference can be maintained at practically zero. Such a method of operation means that power is transmitted at minimum losses, that substantially the maximum kilowatts can be delivered over a given line and the troublesome question of taps on the transformers for the high tension line is avoided.

MEETING NOTICES.

Oregon Society of Engineers.

The annual dinner of the Oregon Society of Engineers will be held in the Green Room of the Commercial Club, Portland, Thursday, February 13, 1913, at 6 p. m. It will be followed by annual business meeting, with speeches by prominent men.

Portland Jovian Electrical League.

The Jovian Electrical League held one of the most successful luncheons ever held in Portland, on Thursday, January 30th, at noon, in the Hazelwood banquet room. Mr. B. Goodwin, chairman for the month, made arrangements for a very instructive and interesting lantern slide lecture, on the hydroelectric development on the White Salmon River, which is being done by the Stone & Webster Engineering Corporation for the Northwestern Electric Company. The lecture was given by Mr. J. H. Manning, superintendent for the Stone & Webster Engineering Corporation. The attendance exceeded 150 members and guests. Mr. C. P. Osborne was chosen by a unanimous vote for the chairman for the month of February.

Oregon Technical Club.

Due to the fact that Mr. A. S. Moody was called to Seattle on business, he was unable to preside as chairman of the luncheon, but sent a substitute in the person of Mr. E. F. Whitney, of the General Electric Company, who conducted the meeting in a very creditable manner. Mr. W. B. Foshay, manager of the Northwestern Electric Company, spoke on his conmpany's present and future plans in and about the city of Portland. He stated that his company was rushing construction as fast as possible. That at present their plant on the White Salmon River is 85 per cent completed and that by March they expect to deliver 2500 h.p. to the paper mill at Camas, which is to be changed to electric drive throughout. The plant on the White Salmon River will be installed complete in nine months from commencing the installation mark. They have worked night and day without interruption. They have installed one of the largest wood stave pipes that is in existence. The diameter is 13 ft. 6 in. The same being especailly designed for this service. All material and apparatus orders have been placed for substation in Portland and for the distributing system within the city.

Portland Jovians.

About fifty members of the Jovian Electric League met at the Hazelwood for luncheon Thursday, January 23d, to discuss different subjects of interest to the people in the electrical business.

A circular letter was distributed by Mr. R. G. Littler, president of the Oregon Electrical Contractors' Association, in reference to the matter of appointment by the state of a board of electrical examiners to examine into the qualifications of parties desiring to engage in the electrical contracting business. A synopsis of the letter was read by Mr. Weber of the Underwriters' Equitable Rating Bureau. A committee composed of Mr. Hartley of the Pacific States Electric Company, Mr. Moody of the General Electric Company, and Mr. Sailor of the Westinghouse Electric & Manufacturing Company were appointed to look into the matter and endorse the State License Law, which is to be introduced in the state legislature this session to regulate all electrical contractors in the state. After luncheon Mr. R. T. Guppy, chief engineer of the Portland, Eugene & Eastern Railway Company, spoke on the plans of his company to construct about three hun-

dred and fifty miles of electrically operated interurban lines, that would begin business in the Willamette valley. He also gave a description of the equipment to be installed, stating that it would be similar to the interurban lines now operating around San Francisco bay. The cars in use will be of steel construction, about fifty-six feet long. The approximate expenditure of this company will be twelve million dollars.

Los Angeles Section A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers helds its regular monthly meeting at Hotel Hollenbeck, on Tuesday evening, January 28, 1913. President George A. Damon was in the chair. There were present 74 members and visitors.

Mr. Damon introduced Mr. Ralph D. Mershon, president of the Institute, who was the honored guest at this meeting. Mr. Mershon gave a very interesting address, reviewing the recently adopted new grade of membership in the Institute, also the possibility of a Pacific Coast Convention of the Institute for Los Angeles in 1914, and the patent situation in the United States.

The paper of the evening was "The Planning of Industrial Cities, with Special Reference to Public Utilities," by Ralph Bennett. It covered the general lay-out of streets and railroad rights of way, the location of railroad tracks for both freight and passenger service, the location of the business and residence section with reference to the industrial plants, the location of utilities, other than railroads, throughout the property, and use of alleys for such purpose and the limitations thrown on the best technical lay-outs by the necessity of land utilization. The paper was illustrated by steropticon views, showing the construction work in progress of the new industrial city of Torrence.

The following took part in the discussion: Messrs. Ralph Bennett, J. E. Macdonald, H. H. Sinclair, R. E. Cunningham, G. A. Damon, Budd Frankenfield and I. F. Dix.

E. R. NORTHMORE,
Secretary L. A. Section.

A NEW RECORD IN JOVIANISM.

The San Francisco Jovians set a new record, not only for the Pacific Coast, but also for this years administration throughout the country. when 119 candidates were rejuvenated at a great joviation and rejuvenation held at the Hotel Oakland, Oakland, Cal., on Feb. 5. ,

During the past week the Jovians have been the livest set of live wires in San Francisco. Frank E. Watts, Eleventh Reigning Jupiter of the Jovian Order, arrived on Monday evening, being met by an enthusiastic reception committee, who escorted him to his hotel and accorded him a royal welcome.

Jupiter Watts was the guest of honor at the regular weekly luncheon on Tuesday which was attended by nearly a hundred Jovians. Here he made a brief address on the recent great strides in membership and spoke of the enthusiasm in each of the cities which he has visited during his tour of inspection. An able address on the progress being made for the Panama-Pacific International Exposition was then delivered by Chas. H. Vogelsang, Commissioner on State and Foreign Organizations.

On Tuesday afternoon he was shown the exposition grounds and the city, and entertained in the evening in true San Francisco style. Likewise on Wednesday.

The crowning feature of his visit was the monster rejuvenation on Wednesday night when the San Francisco degree team conferred the full privileges of Jovianism on 119 candidates from the bay cities at the Hotel Oakland in the city of Oakland.

The rejuvenation was preceded by a banquet, where 220 members of the order gathered around the board. At the conclusion of the banquet Jupiter Watts gave a brilliant talk on the serious tasks which this great electrical organization has undertaken. Besides the practical commercial co-operation which is inculcated, special emphasis is being brought to bear on the question of remedying existing patent laws. The local organization was urged to do its utmost in urging congress to frame proper laws. Songs and music were interspersed with moving pictures of electrical subjects and a most enjoyable entertainment provided.

The rejuvenation was held under the direction of Arthur H. Halloran, statesman for California, with the active assistance of Alternate Statesman W. W. Hanscom, Statesman-at-Large T. E. Bibbins, and Past-Statesman J. E. Sanderson. Particular credit for the success of the rejuvenation is due to the membership committee, on account of whose energy and unselfish devotion this unusually large class was assembled. Those most active were: W. R. Dunbar (chairman); M. L. Scobey, A. E. Rowe, J. A. Hew, M. F. Steel and F. D. Fagan. The committee in charge of the banquet which preceded the rejuvenation was: W. W. Briggs, C. E. Wiggin; F. H. Woodward and J. E. Rowe.

The following officiated in the degree team: Jupiter, A. E. Drendell; Neptune, C. C. Hillis; Pluto, M. L. Scobey; Vulcan, A. V. Thompson; Mars, Albert H. Elliott; Averenim, F. H. Poss; Hercules, John R. Cole; Apollo, G. I. Kinney; Mercury, W. W. Hanscom; Imps, F. H. Woodward, H. E. Sanderson, J. A. Herr, M. F. Steel, W. R. Dunbar, H. A. Daley.

The following candidates were rejuvenated:

Abben, Oscar	Fibush, Martin E.	McKinley, W. L.
Abramson, Mono	Folte, Arno G.	Marcuse, S.
Alexander, Earl G.	Fyfe, Henry B.	Martinez, R. E.
Babcock, G. R.	Gensler, Julius	McCarty, Jas. H.
Baker, Fred D.	Gibson, Burton Y.	McKee, Jas. J.
Baker, Walter R.	Greenhouse, —.	Meinema, Albert
Bantel, Chris F.	Gilkyson, Jno. W.	Mellman, Henry
Batchelder, Harry S.	Gilman, Samuel W.	Myers, Romaine W.
Baumbaugh, Ernest C.	Gregg, W. H.	McManus, J. A.
Beck, Frank G.	Gribble, Wm. H.	Nylen, A. H.
Behan, R. F.	Hampton, E. J.	Neelands, Wm. L.
Belden, J. H.	Harkness, Harold L.	Paine, Henry E.
Bigelow, Chas. L.	Hasselbach, Henry C.	Plankington, J. C.
Bowes, Geo. T.	Hatch, W. G.	Quinn, Edw. A.
Brackett, J. H.	Havey, Harry D.	Quinn, Frank J.
Burns, Wm. T.	Hawken, Samuel L.	Quick, C. E.
Byers, Lande S.	Heise, Carl E.	Rawdon, Walter F.
Crowson, E. A.	Howard, H A.	Reid, Henry C.
Carlson, J. M.	Helfrich, L. C.	Rhine, M.
Carrigan, Andrew	Hermans, Jas. P.	Richmond, Jos. A.
Chamblin, Clyde L.	Hancock, S. L.	Rosenlund, Edw. T.
Cheney, Arthur H.	Hill, Benj. C.	Saurman, Atlee B.
Collins, Thos. E.	Hudson, Robt. A.	Schloss, Lyman A.
Cone, Wm. S.	Hyde, Henry C.	Schnapp, M. H.
Cooley, Frank N.	Johnson, Willard C.	Shreve, Earl O.
Coffin, E. M.	Jones, Geo. D.	Sibley, Robt.
Cox, Harry P.	Kahn, Raymond T.	Smarr, Ben M.
Cunningham, E. T.	Kimball, Hugh W.	Somers, Louis A.
Cutting, Edwin M.	Kinney, Herman B.	Sperry, Lewis E.
Dahlen, Arthur J.	Koch, Geo. A.	Shields, Howard E.
Dewald, Edward G.	Laingor, John S.	Thompson, Jos. S.
Dickinson, R. N.	Lazarus, Jos. G.	Tudhope, Geo. V.
Dillingham, Jos. O.	Leggett, Fred H.	Van Haren, Elvin E.
Dredge, Theo. F.	Lewis, Wm. B.	Van Hoosear, Jno. E.
Doyle, Harrison M.	Lillard, O. W.	Wentworth, Geo. L.
Dyer, E. K.	Loughborough, A. R.	Werner, Wm. M.
Drew, G. G.	Lutz, Aug. J.	White, Howard J.
England, J. A.	Loring, C. A.	Wilson, John E.
Emery C. G.	Morris, T. C.	Wolfe, Harold S.
Ellis, Norman P.	MacPherson, H. F.	

NEWS OF CALIFORNIA RAILROAD COMMISSSION.

Jan. 29.

Upon complaint of the Board of Trustees of Sutter Fort against the San Francisco-Oakland Terminal Power Company, a decision was rendered ordering the restoration of the $60 rate. The company had advanced the season rate to $95.60 at Coloma, El Dorado county, without proper authorization.

A decision was rendered on the application of various public utilities for permission to charge less than the published schedule of rates in certain classes of rates. The decision permits deviations for federal and state governments and the political subdivisions thereof, including the departments thereof, and public institutions, fairs and other public expositions and celebrations, charity as defined in the opinion in this case, and employes.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

EXAMINATION FOR CHIEF INSPECTOR OF ELECTRICITY, PORTLAND, OREGON.

Theory and Practice of Electricity.

1—What governs the various sizes of wires in an installation of wiring?

2—Which is the most important in wiring problems?

3—What is the characteristic feature of the constant potential system?

4—Find the power in watts in a closed circuit in which an electrical energy equivalent to 123,750 foot-pounds is expended in 43.5 minutes.

5—What takes places in a conductor when it is moved across lines of magnetic force at right angles to their direction?

6—(a) In a circuit, the resistance between two points is .23 ohm; what current flowing between these points will cause a difference of potential of 48.4 volts? What is (b) the power in watts? (c) its equivalent in horsepower units?

7—Why is high voltage used for distributing power to great distances?

8—The total resistance of a closed circuit is 12.3 ohms; what is the power in horsepower units when a current of 11.4 amperes is flowing through the circuit?

9—What is the distinction (a) between a ring-wound and a drum-wound armature? (b) between a cylinder and a disk armature?

10—Why is the difference of potential between the terminals of a dynamo armature less than the e.m.f. generated, when the machine is delivering a current?

Electrical Wiring and Apparatus.

1—Why is the use of wire smaller than No. 4 prohibited by the Code except as allowed for fixture work?

2—(a) What is a constant current system? (b) What is a constant potential system?

3—How are three-way switches considered by the National Electric Code? How should they be wired to comply with the requirement of the Code rules?

4—When is the use of metal moulding prohibited by the rules of the National Electric Code?

5—How much above the allowable carrying capacity of the wire may circuit breakers be set; (a) when a fusible cutout is also installed in the circuit; (b) when no fusible cutout is installed?

6—What pressure is usually employed for 32 c.p. incandescent lamps?

7—How should electric heaters be installed to meet the requirements of the National Electric Code rules as to protection and control?

8—Why does the Code require that cutouts be so placed that no set of incandescent lamps requiring more than 660 watts shall be dependent upon one cutout.

9—What determines the places of contact of the brushes upon the commutator of a generator or motor?

10—Is there ever any danger of wires becoming dangerously overloaded if such wires were originally installed in strict accordance with the rules of the Code? State your reasons.

Practical Questions.

1—What advantages does direct current possess over alternating for commercial purposes?

2—What advantages does alternating current possess over direct current?

3—How many amperes equal one horsepower on a 110 volt circuit?

4—What size of wire must be installed to comply with the requirements of the National Electric Code to connect a d.c. motor rated at 80 amperes 110 volts to a circuit the length of which is 40 feet and the drop in which is 40 volts?

5—A circuit requiring 320 amperes is to be installed, the distance from the meter is 280 feet, the voltage is 220; it is desired to keep the drop within 2 per cent, state what size of wire should be installed to comply with the Underwriters' rules.

6—(a) What is the principal advantage of the three-wire system? Explain fully. (b) When may the neutral fuse in a three-wire system be omitted?

7—What are the requirements of the National Electrical Code for the installation of series arc lamps, also multiple arc lamps?

8—If the alternating current mains of a large building are so large that they will not go into one conduit, how should they be installed?

9—Does a blown fuse always mean that there is a short circuit or an overload? State fully.

10—(a) What part of a generator forms in reality a part of the light circuit? (b) What per cent of the whole resistance of a circuit should the lamps connected thereon be?

TRADE NOTES.

The name of the Simplex Electrical Company of Boston has been changed to Simplex Wire and Cable Company. No change of management or interest is effected by the change of name.

The Ohio Brass Company of Mansfield, Ohio, recently secured the exclusive sales rights for the National Railroad Trolley Guard, which is a patented device for preventing electric cars from becoming stalled on steam road crossings when the trolley wheel leaves the wire.

The Oro Electric Corporation have contracted with C. C. Moore & Co. to build a steam plant near Stockton, Cal., as an auxiliary to its extensive hydroelectric system. The first installation will be a 1000 kw. unit, but the plant has been arranged to be extended by adding several larger units, as the business of the company demands. The plant will be constructed in accordance with the best practice in steam engineering. The turbine will be of General Electric make and the boilers B. & W. Stirling type. This plant will be so located that ample condensing water will be available. It will also have both rail and water transportation facilities The contractors have been given orders to rush this plant which is to be ready for operation on May 1st of this year

NEW CATALOGUES.

Sprague Electric Works' publication No. 117 is a handsomely printed listing of the various products they manufacture. For more detailed description reference is made to special bulletins.

Bulletin No. 102, "Proper Lamp Voltages," from National Electric Lamp Association, is a discussion of the selection of incandescent lamps for use on circuits having a fluctuating voltage. Commercial relations of lamp voltage and line voltage are not considered.

"How to Figure Illumination" is the title of a twenty-page booklet recently published by the Sunbeam Incandescent Lamp Works of the General Electric Company. The object of this bulletin is to acquaint the general public with the most simple and up-to-date method of figuring commercial and industrial illumination. It also includes a complete catalogue of Sunbeam Mazda lamps.

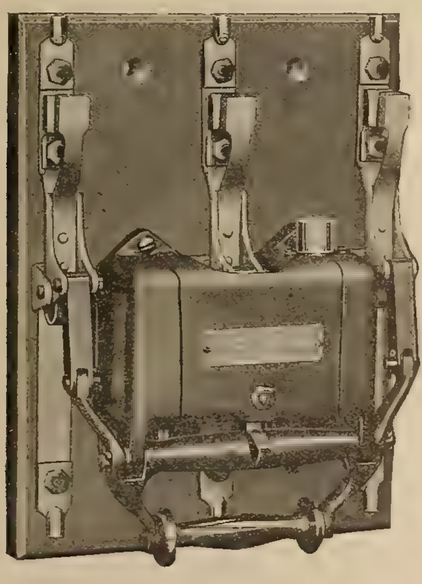
INDUSTRIAL

DIESEL ENGINES IN BRITISH COLUMBIA.

The Municipality of Penticton, B. C., is installing a 200 h.p. Diesel engine made by Mirlees, Bickerton & Day of Hazel Grove, near Stockport, England, as a prime mover for the municipal lighting system. This will suffice until the present population of 2500 increases sufficiently to warrant the construction of a more extensive hydroelectric development. A similar engine has been recently installed at Vernon, B. C., and seven other plants ranging from 150 h.p. to 900 h.p. in Saskatchewan. A working test of the 200 h.p. engine at the factory showed a mechanical efficiency of 77 per cent at full load, the fuel consumption being 0.425 lb. for b.h.p., the oil having a calorific value of 18,000 B.t.u. per lb. F. H. Latimer has charge of the installation at Penticton, as well as of the municipality's irrigation and domestic water system.

THE DISTANT CONTROL OF SMALL CAPACITY POWER AND LIGHTING CIRCUITS.

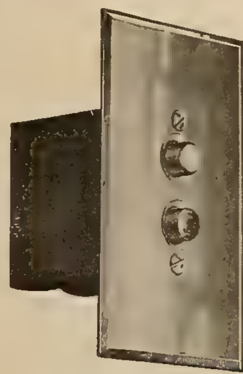
In addition to the service of transmitting messages to distant points instantly, electricity is also utilized to do things at some distant point, and thus also effect a great saving in time, expense and labor. A lighting company furnishing power on a flat rate basis for the operation of signs received numerous complaints when the electrical current was turned off by hand owing to the attendant's inability to be at all the places at one and the same time so as to switch the current off all signs simultaneously. The complaints disappeared when the current was cut off by remote central switches all tripped simultaneously by the throw of a switch at the station.



Electrically Operated, Triple Pole, Remote Control Switch.

Such a distant control switch has a wide field of application. The one shown in the illustration is substantially built and has few operating parts and so is suitable for installation at remote points where it may not receive a very great amount of attention.

The switch is operated by a double coil solenoid—one coil for closing and one for opening—controlled by a special double push button switch which is normally in the open position and remains closed only while held so by the operator. To open or close the switch the corresponding push button has to be pushed in. One of these switches is furnished with each remote control switch and must always be used, as the solenoid coils are not designed to conduct their exciting current continuously. The cores of the operating solenoids are connected directly to the operating lever which in turn is connected to the poles of the switch through a toggle mechanism. When a coil of the solenoid is energized, its core moves the operating lever up or down, forcing the switch closed or opening it, whichever action corresponds to the coil energized. The switch can be operated by hand also, a handle being provided for this purpose and seen at the lower part of the switch in the cut.



Specially Designed Push Button Switch.

This switch is a self-contained unit with two sets of contacts, the main contacts being laminated copper brushes, while the auxiliary ones, on which the arc breaks on opening the circuit, are of carbon. The main contact brushes are so constructed that each lamination makes an end-on contact stud without any tendency to force the laminations apart. The laminations have a wiping effect in closing, thus keeping the contact surfaces bright, and ensuring good contact always. The carbon auxiliary contacts are made of blocks of selected carbon fastened on without screws or bolts, which ensures long life and satisfactory service.

The standard finish of all the live parts of the switch is polished copper, while that of the mechanism is marine (dead black).

The switch is made single, double, or triple pole, single throw for service on alternating and direct current circuits for potentials of 110, 125, 220 and 250 volts, and can be furnished up to 300 amperes capacity.

Besides the service mentioned above it can be used to open or close power or lighting circuits of comparatively small capacity at some distant point. It is also used in office buildings, libraries, and public buildings, being installed in the supply circuits of cabinet panels and controlled from any desired point.

The switch described above is manufactured by the General Electric Company, of Schenectady, N. Y.

ELECTRIFICATION OF THE MELBOURNE SUBURBAN SYSTEM OF THE VICTORIAN RAILWAYS.

Probably the most notable railway electrification project at the present time is that about to be undertaken in connection with the suburban steam railways of Melbourne, Australia. The advisability of the step has been under consideration for a number of years, and in 1908, Mr. Charles H. Merz, of the firm of Messrs. Merz & McLellan, Victoria

street, Westminster, London, presented a comprehensive report on the subject to the Victorian Railway Commission. In this report, Mr. Metz, acting as consulting engineer on the scheme, went very fully into the whole question of the substitution of electric traction on steam railways.

In a later report, embodying a comparative analysis of the merits of both the single phase alternating current and high voltage direct current systems, based on the tenders submitted, Mr. Merz points out that the adoption of the high tension direct current system for this application would mean a saving of about $3,500,000, or nearly 30 per cent. in the cost of installation over that of the single phase system. Accordingly, in view of this initial saving and a further operating economy, as indicated by Mr. Merz, of about $350,000 per annum, or nearly 28 per cent., he recommended very strongly the adoption of the high tension direct current system for the Melbourne Railways and the Victorian Government accepted his recommendations.

The electrification of the Melbourne Suburban Railways is of exceptional interest because it will be one of the largest projects of its kind in the world, involving heavy rolling stock equipment with overhead collectors. The magnitude of the undertaking from the standpoint of equipment and service may be compared with that on the third rail electrified section of the New York Central Railroad out of New York City, and ranks with the Oakland, Alameda & Berkeley electrification of the Southern Pacific Railroad at San Francisco.

Naturally, the great size and tremendous importance of the project attracted world-wide competition, and among the leading manufacturers of electrical apparatus submitting tenders are included the Allgemeine Electricitaets Gesellschaft, Berlin; British Westinghouse Company, Manchester; Dick, Kerr & Company, Ltd., London; Ferranti, Ltd., Hollinwood; Siemens Bros. Dynamo Works, Ltd., London; General Electric Company of New York, and others. After an exhaustive study and consideration of the relative merits of the several propositions, Mr. Merz approved in his report the recommendations of the General Electric Company of New York as to choice of system and economical features of operation, and the Victorian Government awarded this company the contract for the rolling stock apparatus equipment, comprising 400 motor car equipments, consisting of four motors each; 800 control equipments, 400 of which are for trailer cars, and 400 air compressor equipments. This is the largest single order ever placed for electric railway apparatus.

The mileage of the suburban lines included in the scheme is made up of 150 route-miles, or 289 track-miles of running roads, and 34 miles of sidings. The potential selected for this direct current system is 1500 volts. Power will be supplied from a central station at Yarraville, a suburb of Melbourne, in the form of three-phase alternating current at 25 cycles per second and will be transmitted at 20,000 volts to twelve substations at various points on the system, where it will be converted into the operating direct current of 1500 volts. The high tension transmission is by underground cables from the power house to the important substations in the central area, and by overhead wires erected on the same structures which carry the railway track conductors, to the outlying substations. Overhead conductors will be used throughout the system for supplying current to the trains, which will be equipped with roller pantograph collectors. The complete equipment of the railways involves the expenditure of $12,000,000 in round numbers, and Mr. Merz figures the saving of electric operation will amount to about $600,000 in 1915 over the former steam operated lines.

Normal trains, weighing about 180 tons, will consist of two motor coaches and two trailer coaches. The tracks are 5 ft. 3 in. gauge. The suburban traffic amounted to 70,000,000 passengers in 1908; the figure the past year exceeds 90,000,000; and in 1917, when it is expected that the conversion to electric operation will be entirely completed, it is estimated that the suburban lines will carry 150,000,000 passengers per annum. The present plans are accordingly based on provision for this probable increase in the passenger traffic; but all parts of the electrification scheme are arranged so as to be capable of extension from time to time, as the traffic subsequently grows. Handling heavy traffic during the rush hours of morning and evening will be provided for by increasing the length of trains, although for this initial service it is the intention to have the maximum train consist of six coaches.

The motors, numbering 1600 in all, which will be installed in the 400 motor coaches, will be of new design throughout and will embody the most modern developments that the General Electric Company has introduced in railway motor construction. They will be known as Type GE-237, will have inherent ventilation and be provided with commutating poles. They will be rated 140 horsepower at 725 volts and will be operated two in series on 1500 volts.

The method of self-ventilation which will be incorporated in the design of these motors will assure exceptionally effective and uniform cooling. This will be accomplished by a broad-bladed centrifugal fan cast intergral with the pinion end armature core head. Fresh air is drawn into the interior through a screened opening on the upper side of the motor frame at the pinion end. This is circulated over the armature and field coils, under and through the commutator, through longitudinal holes in the armature core, and thence exhausted to the exterior through openings in the pinion and bearing head.

The service on the lines calls for both local and express schedules. The motors will therefore be arranged for tap field control, which will allow a free running speed of 52 miles per hour over level track for the suburban cars on express runs. This method of auxiliary control was introduced by the General Electric Company a number of years ago, but due to commutating limitations of earlier motors, it was eventually abandoned. Its successful application to commutating pole motors is therefore modern.

The 800 control equipments for both motor and trailer cars will be the well-known Sprague-General Electric Type M relay-automatic control and do not require description. They provide for multiple unit operation and control of the train from the platforms of any motor or trailer car. Type M control has been in operation on heavy traction work for many years, notably on the subway and elevated divisions in New York and other large cities, and has demonstrated its simplicity, low maintenance and reliability.

It is interesting to note that two of the principal factors that apparently influenced Mr. Merz and the commissioners to decide in favor of the high tension direct current system, rather than the single-phase alternating current system, were the lower maintenance of the rolling stock equipment and the saving in energy consumption. They found that the greater number and complexity of the electrical parts carried on the coaches in the case of the single-phase equipments not only causes these equipments to be initially more expensive, but also renders them more costly to maintain; and when routine inspection is taken into account, and also the fact that repairs are necessarily subject to the exigencies of traffic requirements, the maintenance of single-phase equipments would exceed that of direct current equipments in a slightly higher proportion than that governing their respective first costs.

Electrification of steam roads both here and abroad has emphasized the fact that the conversion to electrical operation is always accompanied by a faster and more frequent train service, and because of greater convenience, comfort and cleanliness, a general improvement in suburban traveling conditions, while the reduction in working cost and the increased earnings of the line combine to produce larger profits.

NEWS NOTES

INCORPORATIONS.

BAKERSFIELD, CAL.—Southern California Gas Company, $10,000, by A. N. Kemp, A. C. Johnson, E. R. Davis, H. P. Baumgartner and Chas. Foreman, all of Los Angeles.

ILLUMINATION.

EL PASO, TEXAS.—Notice has been given that the El Paso Gas & Electric Company will apply to the city council for a franchise to maintain and operate a gas plant in this city.

VISALIA, CAL.—The Central California Gas Company has secured permission to lay gas pipes in the county roads that the Porterville, Lindsay, Exeter, Visalia and Tulare stations might be connected.

INGLEWOOD, CAL.—The Los Angeles county supervisors have awarded the contract for street lighting of Hyde Park to the Southern California Edison Company. The system is to be installed by June 1.

PORTLAND, ORE.—Ornamental street lighting for Sandy Road is the scheme of the Rose City Park Club. The proposition is to illuminate the boulevard with electroliers from Burnside to East Seventy-second street.

SALT LAKE CITY, UTAH.—Extensive improvements in the gas systems of this city to meet the needs of the city's growing business and residential sections are to be carried out this year by the Utah Gas & Coke Company.

BREMERTON, WASH.—An application for a gas franchise was presented by E. R. Downie of Seattle. The franchise is asked in the name of Chas. R. Shepherd, a principal stockholder in the gas plants of Everett, Raymond, South Bend and Montesano.

ANAHEIM, CAL.—Sealed bids will be received up to February 5th for a franchise to lay and maintain a pipe line along certain portions of Orange county for the purpose of transmitting natural gas for light, heat and power purposes, in accordance with conditions set forth in terms of the franchise.

SAN FRANCISCO, CAL.—An opinion against the Pacific Gas & Electric Company's claim of franchise rights has been given to the Board of Supervisors by City Attorney Long, who says that this company stands on the same footing as other lighting companies and that the only rights belonging to it with regard to the use of streets are such as it acquired under section 19 of article 11 of the state constitution. This section was amended in October, 1911, and the laying of pipes and conduits and erection of poles on streets cannot now be carried on in the free way allowed prior to the amendment, as the regulating power of the municipal authorities has been increased. The Pacific Gas & Electric Company based its franchise claim on order No. 1667, which was passed by the supervisors on March 20, 1882, and it relied also on resolutions adopted by the board in 1881 and 1899. The city attorney holds that the supervisors had no authority either under the old consolidation act or any other enactment to grant this franchise.

TRANSMISSION.

TOLEDO, ORE.—Lewis Montgomery of Portland has purchased the Toledo electric plant. He plans new machinery in a building which will erected especially for a power plant.

YUCAIPA, CAL.—Surveys are now being made for extension of the high power lines of the Southern California Edison Company from Mentone into and through Yacaipa valley.

MODESTO, CAL.—Chas. Northcutt, representing the Sierra & San Francisco Power Company has been granted permission to run a power line along the county road from the Oakdale road to Claus.

SIERRA CITY, CAL.—Dennis Phelan, managing director of the Sierra Mercantile Power & Mining Company, is in San Francisco arranging for the purchase of machinery for an electric power plant to be erected here in the spring for the operation of the Sacred Mound mine and mill.

RENO, NEV.—Following the filing of a trust deed for $3,000,000 to obtain bonds to the amount, engineers of the Mono Valley Power & Light Company have been instructed to commence work on a power plant below Reno. A large dam is to be constructed just above the government's dam at Derby. Work must be started within six months, according to the trust deed which was filed in Washoe and Storey counties. The company is to supply power to Reno in competition with the present Truckee River General Electric Company's plant. The Mono company already is supplying Goldfield and Southern Nevada camps with power. The company is backed with Oakland capital.

TULARE, CAL.—The hearing of the application of the Tulare County Power Company before Commissioner Loveland for leave to issue $300,000 6 per cent gold bonds called forth unexpected opposition. Just as A. M. Drew of Fresno and W. H. Orrick of this city, counsel for the company, were about to open their case, Jesse W. Lilienthal appeared with an intervention on behalf of the Mt. Whitney Power & Electric Company, and Robert J. McGahie filed an opposition to the granting of the application on behalf of Fred W. Corcoran, a dissatisfied holder of the preferred stock. The opposition of the Mt. Whitney company is based on the threatened invasion of its territory by the Tulare concern. C. H. Holley, the secretary and general manager of the Tulare Company, testified that the proceeds of the bond issue were to be utilized in paying off an indebtedness of $228,000 and for constructing an additional distributing system and developing a water right on Tule River. His company, he said, was operating 234 miles of electric distributing lines in Tulare county now, and desired to add 100 miles more to accommodate customers who had contracted for current.

SAN FRANCISCO, CAL.—City Engineer M. M. O'Shaughnessy and A. W. Maltby, a water power expert of New York City, sat as representatives of Secretary of the Interior Fisher in an all-day conference in the postoffice building, hearing all sides in the Lake Tahoe dispute. Representatives of the Lake Tahoe Protective Association argued against any scheme for constructing a dam and enlarging the natural channel of the Truckee River so that more water would be drawn from the lake than ordinarily flows out in the course of a year. The U. S. Reclamation Service, represented by Engineers Hobson and Davis and by John F. Truesdale, special assistant to the attorney general, sided with the representatives of the Truckee River General Electric Company in the plea for the privilege of lowering the body of water six feet if necessary. The lowering of the level of Lake Tahoe, according to W. M. Bliss, who represented the owners of the Tahoe Railway, the Tahoe Tavern and the other big resorts along the shore would result in damage amounting to $1,500,000 rendering certain localities along the southern side of the lake inaccessible by steamers because of shallows.

TRANSPORTATION.

LOS ANGELES, CAL.—The city council has sold the 21-year franchise for the extension of the Vernon avenue car line to the western city limits, to H. E. Huntington.

MEDFORD, ORE.—The F. P. Minney Company of Oakland, holders of an electric road franchise in this city, which plans to construct interurban lines throughout the Rogue River Valley, has closed a deal for the purchase of the F. W. Waite tract, 1½ miles from Ashland. The tract consists of approximately 2000 acres. The price was $400,000.

LOS ANGELES, CAL.—Bonds in the sum of $5000 to provide satisfactory completion of the laying of tracks by the Pacific Electric Company on San Pedro street, to be used by the Pacific Electric and municipal railways, has been approved by the city council. According to the terms of the contract the Pacific Electric is allowed five months to complete the work.

SAN FRANCISCO, CAL.—A resolution has been adopted by the supervisors' public utilities committee calling upon the United Railroads to extend the Brannan street line on to the Mail docks. This will require only a block of single track in First street and an outlay of but $5000. The United Railroads wants a permit to make a switch connection at Presidio avenue and California street to run empty cars of the Jackson street line to the Clement street carbarn. The company will get the permit if it guarantees to build the much needed line to the Mail docks.

FRESNO, CAL.—The Fresno-Hanford Summit Lake Railway Company has applied to the Railroad Commission for authority to issue $1,250,000 of bonds. It is proposed to use the proceeds in the construction of an electric railroad running from Fresno easterly to the town of Centerville, Fresno county, and southeasterly to the town of Kingsburg, Fresno county. The distance is 40 miles. The applicant states that it has procured practically all of the needed rights of way and has completed the roadbed over most of the route, and has constructed culverts over all waterways. It states also that it has obtained the necessary franchises.

SAN FRANCISCO, CAL.—Plans and specifications for the extension of the Geary street road to the Ferry have been approved by the supervisors' public utilities committee, and the board of works authorized to call for bids for the laying of the tracks from Kearny street down Market to Sansome, where the cars will proceed on outer tracks to the Ferry loop. City Engineer O'Shaughnessy announced that all is in readiness for building the extension, and that provided no legal obstacles are thrown in the way, the Geary cars will be running to the waterfront in 40 days. Regarding the westerly extension from thirty-third avenue to the beach, O'Shaughnessy said that the grading is now under way and will be completed in 30 days. Within 60 days the tracks will be laid and cars running to the ocean terminal.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railway, the name under which the Key Route now operates, has taken the first step towards converting its present Key Route pier into a mole by awarding a contract to Twohy Bros. for the filling in of the Key Route pier at a cost approximating $2,000,000. Work is to be started immediately, and, while the contractors fill in the pier they will increase the number of tracks from two to eight. While the Key Route's plans for the enlargement of its terminal facilities at Oakland provide for an immediate expenditure of but $2,000,000, the improvement work will ultimately cost in the neighborhood of $7,000,000, the latter sum covering the cost of erecting new and more extensive train sheds and the installation of junction points along the pier for the accommodation of freight traffic. The Key Route pier, according to the terms of the contract, is to be filled in with granite, rock and gravel and made as substantially solid as possible. Most of the rock is to be taken from the big hill between Piedmont avenue and Broadway, just outside of St. Mary's Cemetery. In some places, especially where junction points along the pier are to be established, the new mole will be 1000 feet wide. Twohy Bros, the construction firm awarded the contract for the pier work, were formerly located in Spokane and did much of the extension work for what is now the Oregon-Washington Railroad & Navigation Company. When they begin the work for the Key Route it will be the first time in many years that they have been engaged on anything save Harriman railroads.

TELEPHONE AND TELEGRAPH.

ALPINE, TEXAS.—The business men of this city are considering a project for financing a co-operative telephone exchange.

PRESCOTT, ARIZ.—The 4-mile telephone line running from Thompson valley to Hillside station on the San Francisco, Prescott & Phoenix Railroad, has been sold to J. D. Cage by L. O. Phippeney.

BLYTHE, CAL.—Announcement has been made that the Imperial Telephone Company has sold the valley plant to the Pacific Telephone & Telegraph Company and that the latter will soon start to rebuild the entire system.

REEDLEY, CAL.—E. W. Crosby and associates, owners of the Reedley Telephone Exchange, have sold their interests to A. Terkel of San Francisco, who, at the present time, is superintendent of the commercial department of the Pacific Telephone & Telegraph Company here. The capital stock of the new Reedley company, which will be known as the Reedley Telephone Company, is $25,000, and the majority of the stock has already been sold. The incorporators are: A. Terkel and Dr. Ira Dick of San Francisco, Dr. G. H. Therhof of Livermore, D. C. Krehbiel and E. W. Crosby of Reedley. The new owners state that they will make a number of improvements.

WATERWORKS.

VALLEJO, CAL.—About 300 water meters will be purchased by the city. A provision of $3000 for this purpose was included in the budget for the present fiscal year.

LOS ANGELES, CAL.—Commissioner Loveland of the State Railroad Commission, heard the application of the San Dimas Water Company to purchase the entire holdings of the San Dimas Irrigation Company, the Artesian Belt Water Company and the Charter Oak Reservoir Company. No protest was entered against the proposed purchase.

RENO, NEV.—The councilmen have been convinced that the present system of the Reno Power, Light & Water Company is entirely inadequate to supply the city during periods of winter weather. The committee submitted a report stating that investigation had been made and the only remedy was the piping of the Highland ditch and the establishment of a subsidiary pumping plant. This matter will be taken up at the next meeting of the council.

GLENDALE, CAL.—The Verdugo Pipe & Reservoir Company has asked for bids on about 1100 feet of second-hand 3-inch No. 16 sheet steel water pipe stored on the grounds of J. P. Lukens, on the roadway near Verdugo road. Included in the same lot is a quantity of 4-inch (second-hand) which will go with the 6-inch pipe without charge, value taken into consideration on bid for first described pipe.

SAN FRANCISCO, CAL.—Supervisor Andrew J. Gallagher's plan for the extension of water mains to suffering districts by use of Hetch Hetchy funds has been approved by the supervisors' utilities committee. A resolution was adopted calling upon the board of works to purchase the pipe and prepare plans for the installation of the mains in the Richmond district in the blocks bounded by Geary street, Thirteenth avenue and Twentieth avenue.

PROFESSIONAL DIRECTORY

ALPHABETICAL INDEX TO ADVERTISERS

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National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
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Cord, Telephone
Kellogg Swbd. & Supply Co.
Pierson, Roeding & Co.
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General Electric Company
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D. & W. Fuse Company
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Pacific States Electric Co.
Western Electric Company
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Benjamin Electric Mfg. Co.

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Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

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D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M Co.

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D. & W. Fuse Company
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Aluminum Co. of America
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Seattle, Colman Bldg.

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San Francisco, 755 Folsom
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Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
Electric Agencies Co.
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Mazda, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pierson, Roeding & Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.
Manhattan Elec. Supply Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
Fairbanks, Morse & Co.
General Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Pittsburg Piping & Equip. Co.

Plugs, Flush
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks, Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo.
(Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Push Buttons
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
Pierson, Roeding & Company
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Manhattan Elec. Supply Co.
San Francisco, 403 Atlas Bldg., 604 Mission St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Moloney Electric Co.
San Francisco, Rialto Bldg.

Nason & Co., R. N.
San Francisco,151 PotreroAve.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 523 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 703 Spaulding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco,MonadnockBldg

Post Co., The Frederick
San Francisco, 135 Second

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
LosAngeles, Union Trust Bldg.

Searchlights
- "Dayton," Elec. Agencies Co.
- Fort Wayne Electric Works
- General Electric Company

Separators, Steam
- Pittsburg Piping & Equip. Co.

Shades
- Benjamin Elec. & Mfg. Co.

Sockets and Receptacles
- Benjamin Elec. & Mfg. Co.
- "Freeman," Elec. Agen. Co.
- General Electric Company
- Manhattan Elec. Supply Co.
- Pacific States Electric Co.
- The Cutler-Hammer Mfg. Co.
- Johns-Manville Co., H. W.

Solder, Self-Fluxing
- Kellogg Swbd. & Supply Co.
- Western Electric Co.

Soldering Paste
- Blake Signal & Mfg. Co.
- Pacific States Electric Co.
- Westinghouse Elec. & Mfg. Co.

Surveying Instruments
- Post Co., The Frederick

Staples, Insulating
- Blake Signal & Mfg. Co.
- Pacific States Electric Co.
- Western Electric Company

Starters (Hand) D. C. and A. C.
- General Electric Company
- Westinghouse E. & M. Co.

Starters (Self), D. C. and A. C.
- General Electric Company
- Westinghouse E. & M. Co.

Steel Castings
- Columbia Steel Co.

Street Cars
- "Brill,"Pierson, Roeding & Co.

Switches, Float
- General Electric Company
- Westinghouse E. & M. Co.

Switches, Disconnecting
- General Electric Co.
- K-P-F Electric Co.
- Pacific Electric Mfg. Co.
- Westinghouse E. & M. Co.

Switches, High Tension
- Bowie Switch Co., The
- General Electric Co.
- Westinghouse E. & M. Co.

Switches, Knife
- General Electric Company
- Manhattan Elec. Supply Co.
- Pacific States Electric Co.
- Western Electric Company
- Westinghouse E. & M. Co.

Switches, Oil
- General Electric Company
- Pacific Electric Mfg. Co.
- Westinghouse E. & M. Co.

Switches, Pendant
- General Electric Company
- Westinghouse E. & M. Co.

Switches, Push Button
- "M. & M." Elec. Agencies Co.
- Manhattan Elec. Supply Co.
- Pacific States Electric Co.

Switches, Snap
- The Cutler-Hammer Mfg. Co.
- Manhattan Elec. Supply Co.
- Pacific States Electric Co.

Switches, Solenoid
- The Cutler-Hammer Mfg. Co.

Switches, Poletop
- Bowie Switch Co., The
- General Electric Company
- Pac. Elec. Mfg. Co.
- Pacific States Electric Co.

Switchboards, Power
- Fort Wayne Electric Works
- General Electric Company
- Western Electric Company
- Westinghouse E. & M. Co.

Switchboards, Telephone
- Dean Electric Co.
- Kellogg Swbd. & Supply Co.
- Western Electric Company

Tanks, Steel.
- Western Pipe & Steel Co.

Tape.
- General Electric Company
- Johns-Manville Co., H. W.
- N. Y. Insulated Wire Co.
- Okonite Company, The
- Pacific States Electric Co.
- Western Electric Co.

Telephone Equipment.
- Dean Electric Co.
- Kellogg Swbd. & Supply Co.
- Manhattan Elec. Supply Co.
- Pacific States Electric Co.
- Western Electric Company

Tel. Protectors and Terminals.
- "Cook," Elec. Agencies Co.

Tools, Construction.
- Klein, Mathias & Sons
- Pacific States Electric Co.

Towers, Steel.
- Pierson, Roeding & Company

Transformer Winding.
- K-P-F Electric Co.

Tubes and Bushings
- Ohio Brass Company

Transformers
- Crocker-Wheeler Co
- Fort Wayne Electric Works
- General Electric Company
- Moloney Electric Co.
- Western Electric Company
- Westinghouse E. & M. Co.

Trolley Bases
- Ohio Brass Co.
- Holabird-Reynolds Co.

Turbines, Steam.
- General Electric Company
- "Rateau," Wilson Mach. Co.
- Western Electric Company
- Westinghouse Machine Co.

Turbines, Water.
- Pelton Water Wheel Co.

Valves
- Pittsburg Piping & Equip. Co.

Vacuum Cleaners, Electric.
- American Ever-Ready Co.
- "Spencer Turbine," Mach. & Electrical Co.
- Pacific States Electric Co.

Washing Machines
- Pacific States Electric Co.
- Western Electric Co.

Water Supply Systems.
- Fairbanks, Morse & Co.
- "Kewanee,"Simonds Mchy Co.

Wire, Aluminum.
- Pierson, Roeding & Company

Wire, Annun's and Office.
- Standard Und. Cable Co.
- Western Electric Company

Wire, Armored
- General Electric Company
- Sprague Electric Works
- Standard Und Cable Co.

Wire, Asbestos-Covered.
- D. & W. Fuse Company.
- General Electric Company
- Johns-Manville Co., H. W.
- Western Electric Company

Wire, Bare Copper.
- General Electric Company
- National Con. & Cable Co., The
- Pacific States Electric Co.
- Pierson, Roeding & Company
- Standard Und. Cable Co.

Wire, Enameled.
- General Electric Co.
- Western Electric Company

Wire, Magnet.
- D. & W. Fuse Company
- General Electric Company
- Kellogg Swbd. & Supply Co.
- Standard Und. Cable Co.
- Western Electric Company

Wire, Rubber-Covered.
- General Electric Company
- Habirshaw Wire Company
- Indiana Rubber & Ins. W. Co.
- N. Y. Insulated Wire Co.
- Okonite Company, The
- Pacific States Electric Co.
- Standard Und. Cable Co.

Wire, Trolley.
- Bridgeport Brass Company

Wire, Weatherproof
- General Electric Company
- National Con. & Cable Co.,The
- Okonite Company, The
- Standard Und. Cable Co.
- Western Electric Company

ADDRESSES.

Thomas & Co., R.
- San Francisco, 680 Folsom
- Oakland, 507 Sixteenth
- Los Angeles, 119 E. 7th.
- Seattle, 1518 1st Ave. So.

Van Emon Elevator Co.
- San Francisco, 56 Natoma.

Western Electric Co.
- San Francisco, 680 Folsom St.
- Oakland, Cal.
- Los Angeles, Cal.
- Western Electric Company

Western Pipe & Steel Co.
- San Francisco, 444 Market
- Los Angeles, 1758W.Broadway

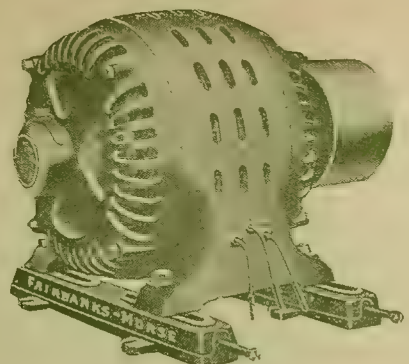
Westinghouse E. & M. Co.
- Denver, 1052 Gas&Elec. Bldg.
- Los Angeles, 527 So. Main
- Seattle, Central Bldg.
- Salt Lake City, 212-214 So. W. Temple.
- San Francisco, 165 Second
- Spokane, Paulsen Bldg.
- Portland, Couch Bldg.
- Butte, Lewisohn Bldg.

Westinghouse Machine Co.
- San Francisco, 141 Second

Westinghouse-Church-Kerr Co.
- San Francisco, 839 PacificBlg.
- Los Angeles, Cal., Pacific Electric Bldg.

Weston Elec. Instrument Co.
- San Francisco,682-684 Mission

Wilson Machinery Co.
- San Francisco, 361 Market



Type G—Exploded View, showing how switch is fastened to adjustable swivel.

Type H with ⅜in. Female Nipple, Metal Cover

Type HA, with Wire-Hole Porcelain Cover.

Type GL, with Pull Receptacle

Type GT, with ⅜ in. Male Nipple Porcelain Cover

Type GX, with Rosette

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POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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JOURNAL OF ELECTRICITY
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VOLUME XXX SAN FRANCISCO, FEBRUARY 15, 1913 NUMBER 7

RIVERSIDE'S MUNICIPAL POWER PLANT

BY C. F. BACKSTRAND.

In 1895 Riverside voted 20-year bonds of $40,000 to be used in constructing a substation and distributing lines. These bonds were to be paid for in twenty installments, together with interest as it became due. There was built a substantial brick building to serve as the substation and 3-83 1/3 kw. Wagner transformers were installed with 10,000 volt primaries and 2000 volt secondaries connected delta to delta. There was also included a switchboard with the necessary instruments and switches. About 12 miles of distributing lines were built. This was thought by many at that time to be in excess of anything that would be required for a long time to come.

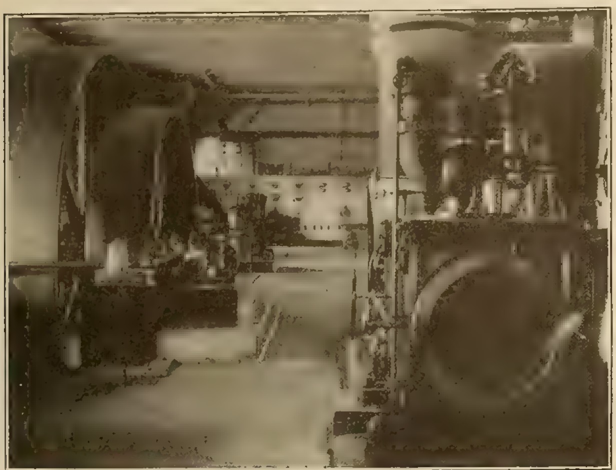
Unique Mission Street Lighting Posts at Riverside, California.

From these small beginnings there are today three separate sources of power, one from the steam plant, one from the 10,000 volt line and the other from the 33,000 volt line. The feeder circuits are so connected that they can be supplied with current from either source. The city is buying its power from the Edison company on two distinct rates. The power delivered on the 10,000 volt line is bought by the horsepower, figured from the readings of the voltmeter and ammeter as already mentioned, while the power delivered on the 33,000 volt line is bought by the kw. figured from the reading of a voltmeter. These feeder circuits are delivering power for both lights and motors so that the power factor is always varying. Circuits with high power factor are supplied with power from the 10,000 volt line and the circuits with low power factor from the 33,000 volt line. This switching back and

forth has apparently not affected the service as much as it would appear, for it can be done without losing any of the load and the change only comes about once a day.

Load Conditions.

The city has developed a large motor load which consists mostly of irrigating plants, although it also furnishes power for every enterprise within its dis-



Steam Plant at Riverside.

tributing system. The power rates are computed on a sliding scale ranging from 6c a kw.-hr. to 2c, with a minimum of two dollars a month, while the lighting rate is 9c a kw.-hr., with 50c a month as the minimum. The minimum rate for power in this city is a special feature, for no matter what the connected load, it holds good. There is no charge made to the consumer for the transformers used. This minimum charge has been satisfactory, although in the past there was often times an advantage taken by the consumer in that he guessed at what his load would be and installed a motor much larger than he needed. This has lowered the power factor on some of the circuits more than it should be. Much more attention is paid to the motor installation now so that this bad feature is being overcome.

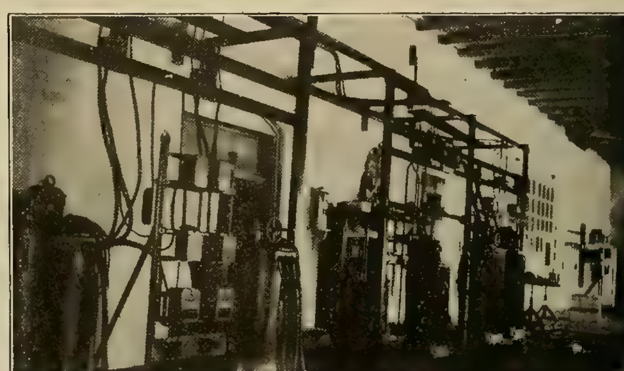
The feeder circuits are all three-wire, three-phase. In the business section the transformers are connected in banks of three, feeding three-phase 220, three-phase 110 and single-phase 110. The longest feeder circuit is about 11 miles.

The arrangement for the purchase of power for the last few years has been such that the steam plant has been operated but little. It has, however, always been in readiness to pick up the load should the service over which either transmission line be such as to demand it. On a good many occasions this has proved to be a great help. The steam from the boilers is also used by the street department in heating oil for road purposes. There is a large storage tank holding several cars of oil located near the station and steam is always kept circulating through pipes in this tank.

Supply House and Renewals.

There is also maintained by the city a complete stock of electrical supplies for retail purposes, besides a large stock of material for construction work for their own use. All supplies are sold as near cost as possible. In addition to this all lamps that are sold by the city are renewed free of charge, including the Mazda lamps from 20 watts to 500 watts, whenever burned out. If a new consumer, who has just been connected up has no lamps and he wishes to take advantage of free renewals, it is necessary for him to purchase his first supply from the city. These lamps are all stamped with the city mark and only lamps with this mark are renewed. It is also necessary for him to bring the lamps to the city office to get his renewals. During the month of November, 1912, the lamp renewals amounted to about $500, and one interesting fact was that the cost of the carbon renewals and the Mazda renewals did not vary over $15 for this same month. It has also been found by the city that the average bill to consumers using light has not been any less because of the use of these high efficiency lamps, but that the consumer just uses that much more light.

When the Mazda or tungsten lamps, as they were first called, were put on the market it appeared for a while as if the city could not maintain this system of free renewals with this type of lamp. They specified at the purchase or renewal of a tungsten lamp that it must be installed in a fixture controlled with a wall switch and that the lamp should hang straight down. The consumer was cautioned as to how to carry the lamp. Regardless of this, if the lamp was carried to its destination without being broken it was installed oftentimes in positions just opposite to the directions. This got so bad that the city executives refused to let the consumer take the lamps with him.



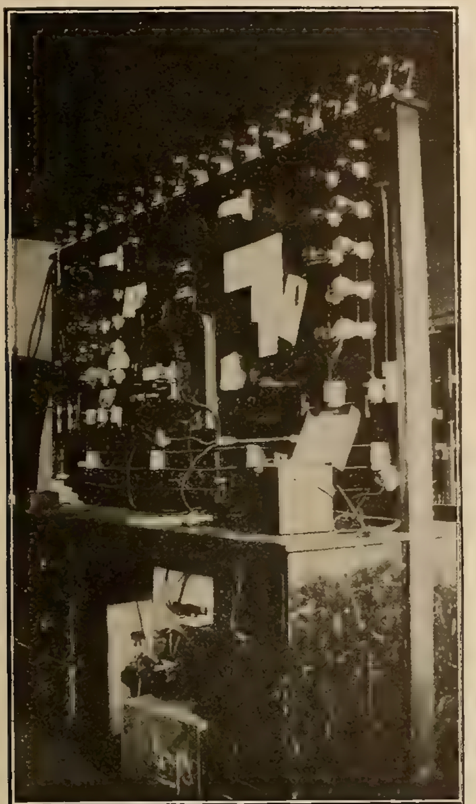
Potential Regulators Recently Installed.

A lamp man was consequently sent to install them and if he found that the requirements were not met with, he brought them back.

This was a big step in the right direction, for it lowered the cost of Mazda renewals enough so that the city could afford to keep up this system with this type of lamp, although a good many consumers still abused the privilege, taking the lamps out after they were installed and using them wherever and however they pleased. It was not long, however, until these lamps were made with the filaments much stronger so that now the customer is allowed to take his lamps and install them wherever he wishes.

Wiring Department.

There is a wiring department in connection with the plant. Wiring of all sorts is done—from the repair of a key socket to the wiring and installing of a pumping plant. There are, however, no contracts taken on any work, everything being done on a strictly time and material basis. For any small work which only requires a few minutes, such as repairs of switches, sockets, or putting in fuses, no charges are made.



Meter Testing Panel.

The city also has an efficient meter department. This department has charge of all the installing and reading of meters, besides the testing and repair work. All meters are tested before they are installed and in addition to this the power meters are tested after they are installed. This department goes over all of the light meters about once in two years, all of the power meters twice a year and in the case of the larger consumers at least four times a year. In conjunction with the meter department is a motor department, where repairs on all sizes and types of motors are made, including transformer repairs and tests.

Unique Street Lighting.

The citizens of Riverside pride themselves on their street lighting. In the past two years they have been installing an ornamental system of street lighting in all of the downtown streets. To carry out the mission style of architecture, the posts for the street lighting have been made of cement with three lights and a cross on top. All of these posts are equipped with tungsten lamps. Up to date there has been 599 of these posts installed. In the outer sections the method has been to install a 16 c.p. lamp about every 150 ft. Some of the streets are lighted in this manner for a distance of 9 miles, there being at the present time about 2500 of these lamps, including 54 arc lamps connected in multiple. There is now under construction several miles of ornamental lighting work. The total cost per kw.-hr. of current consumed for street lighting, including cost of maintenance and office expense, has been $.0216.

The value of the substation and steam plant, including the 12 miles of distributing lines did not exceed $80,000, while the present value of the plant is placed at $320,249.96, including 112 miles of lines. The brick building first put up has been added to until now it is several times as large. The land owned by the city and used for the electrical department occupies half a block. During the first two or three years of operation the load did not exceed 200 h.p., while during the past 10 months the average daily load has been over 1000 kw. and the plant has been added to until now it has a capacity of about 1800 kw.

Statement of Progress.

The total current received and distributed for the year 1911-12 was 4,900,180 kw.

The total revenue	$148,096.83
Total expense	102,031.81
Net earnings	46,065.02
Total surplus	8,245.59
Total depreciation fund	50,197.13
Total number of consumers of light	3,302
Total number of consumers of power	396
Total number of consumers	3,698

Detail View of Mission Ornamental Post.

The plant employs 32 people constantly, most all of whom own their own homes. During the existence of the plant no damage suits, lives lost or fires have been caused by faulty construction or negligence of duty on the part of employes. All bonds have been retired as they became due and also all interest on the same paid by the profits of the plant.

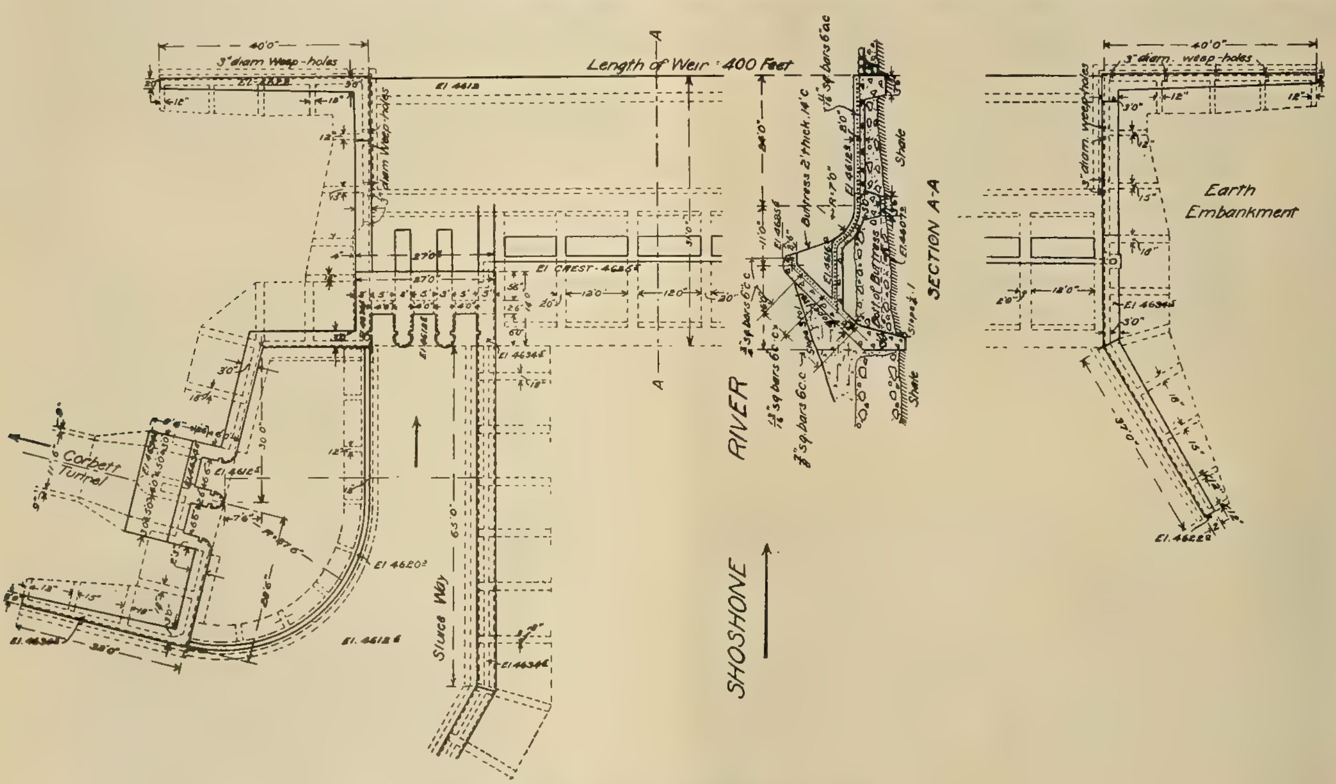
ELECTRICAL PUMPING AND IRRIGATION

SLUICES, FISHWAYS AND LOGWAYS.

BY. B. A. ETCHEVERRY.

A scouring sluice or sluiceway is an opening made in a closed weir, while an undersluice is an opening made through the body of the weir and does not extend to the top crest of the weir. The object of these sluices is to allow the passage of sand and silt and to keep a clear channel in front of the headgates and to prevent the entrance of sand in the canal. Undersluices are only used for high diversion weirs and where the volume of silt and sand is not large. As the chief purpose of the sluices is to keep a clear channel in front of the headgates, the sluices should be located at this end of the weir. The scouring effect is maximum at the opening itself and diminishes with the distance upstream from the sluice, in some cases higher velocities through the sluices, the lengths obtained should be increased 50 per cent. To confine the scouring effect the upstream wall can be continued downstream to the end of the floor. This wall with the parallel bank of the river forms the downstream scouring channel. The bank of the river must be protected by a wing wall or by paving which will extend for a distance equal to the length of the floor.

The effect of the sluiceways described above is to form a deep channel in front of the gates. While this is very desirable and necessary, it has the disadvantage that it throws the force of the current on one flank and on sandy streams with water carrying considerable silt may have a tendency to form islands



Dam and Headworks of Shoshone Project.

extending only a short distance. To concentrate the scouring effect in front of the headgates which may be necessary for streams carrying much silt, a channel can be formed by building a wall parallel to the headgates at a distance from them equal to the width of the sluices with a floor in between and extending upstream beyond the upstream edge of the headgates. This is well illustrated by the accompanying plans of the sluiceway in the granite reef dam on the Salt River, Arizona, at the intake of the south canal, and by the plan of the sluiceway in the Corkett dam on the Shoshone River, Wyoming. On sandy foundations it is necessary to extend the floor at the sluiceway a considerable distance downstream to protect the stream bed. The design of floor thickness, floor length and length of riprap is based on the same principles as weir floors. However, because of the above the weir. To prevent this and to keep a channel in the center of the stream, scouring sluices in the center of the stream would be desirable. However, the difficulty of access to them during flood times is a great objection and in some cases their use would be impraticable.

The only practical method of preventing silt islands is to use a lower weir with collapsible gates or shutters to raise the weir crest during the low water period. These difficulties are usually encountered only with broad rivers carrying considerable sand and silt.

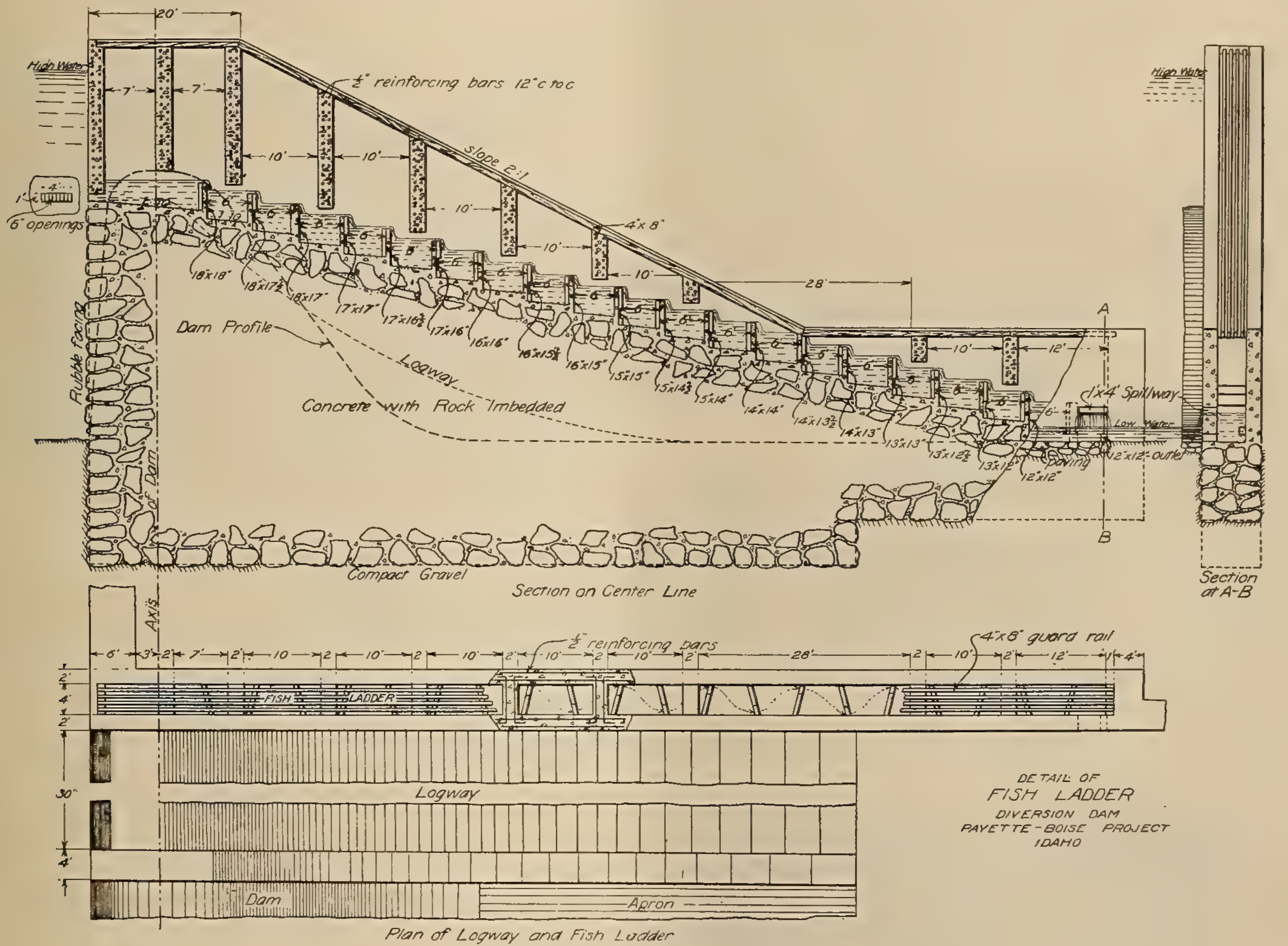
The other factors to be considered in the design of the sluiceway are: (1) relative elevation of sills of headgate and sluiceway; (2) width of openings; (3) superstructure.

1. The efficiency of the sluices depends largely

on the relative elevation of the sills of the headgates and the sluices. The sill of the sluices is generally placed at the level of the stream bed or else at low water level. In any case the sill of the sluice should be made lower than that of the headgates by at least 2 to 4 ft. and preferably more, unless this would produce an excessive pressure on the sluice gates.

2. Where the amount of sand and silt is considerable, the scouring sluice should be designed to offer as little obstruction as possible and allow a large velocity to wash out any deposits. This can best be done by using enough large openings with comparatively narrow piers, or by using collapsible shutters. The practice in India, where the rivers carry considerable silt, is to use wide openings from 10 ft. to even 20 ft., with thickness of piers equal to about 1/3 the width of the openings and to make the total cross section area of the opening equal to that of the headgates.

3. The superstructure, when lift gates are used, consists of the operating platform and piers with grooves into which the gates are fitted. For wide gates, roller bearings are used. The piers, gates and platform are designed as for headgates. When collapsible gates are used no piers or operating platform are usually necessary. It is difficult to make collapsible gates which will work successfully for heads above 4 to 6 ft. Often there is no advantage in using them in the sluiceway, because trees and large floating debris can be trained with log booms to pass through a log way or over the dam.



Typical Logway and Fish Ladder.

Fish Ladder.

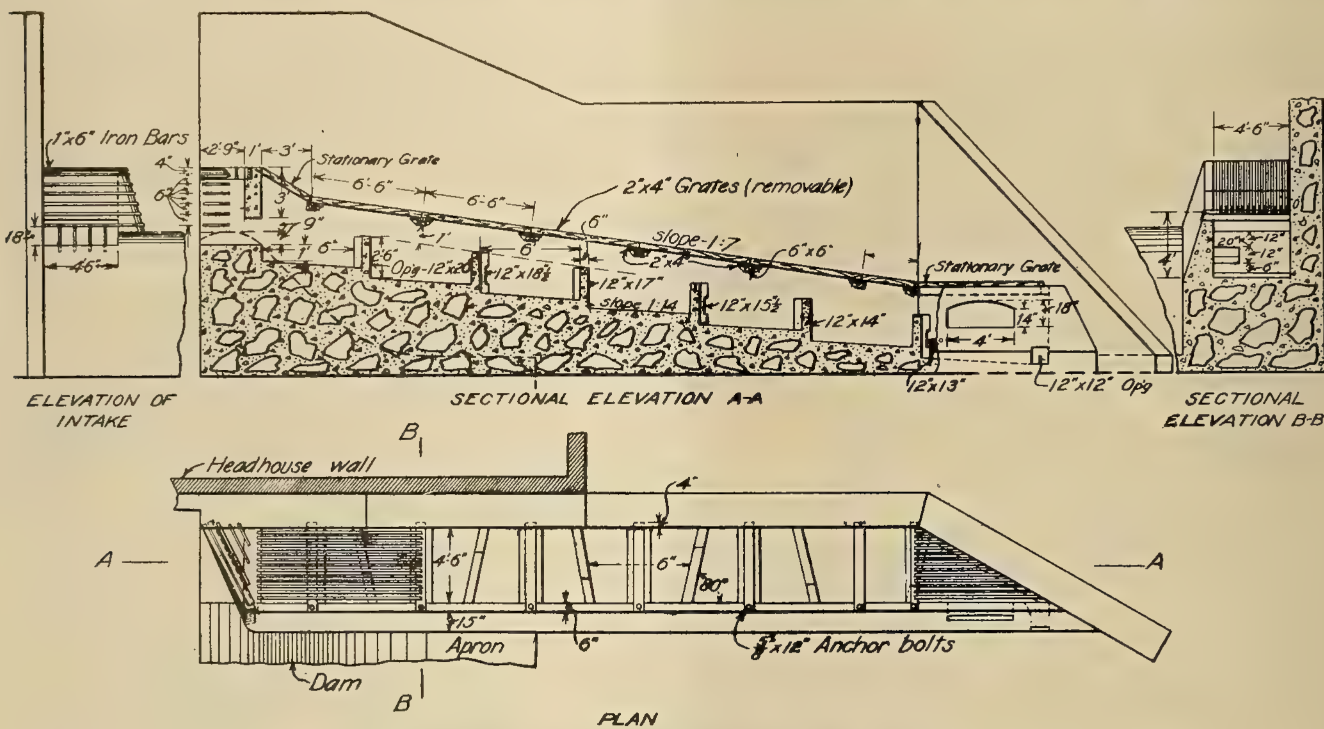
The laws of many states require that fish ladders be placed in all weirs or dams to permit the fish to pass upstream. For rivers whose summer flow is small the water may be confined to a channel upstream and downstream from the sluiceway. For these cases it is necessary to place the fishway adjacent to the sluiceway. A fish ladder consists of a series of basins forming a set of steps. These basins are connected by means of openings so that the fish can pass from the lower basin to the upper basin. The inlet to the lower basin must lie lower than the low water level on the downstream side of the weir and the outlet to the upper basin is on the upstream side of the weir below the weir crest. To insure a full supply in each basin the upstream opening for each basin is made a little larger than the downstream opening so that the openings gradually diminish from a maximum at the top to a minimum at the bottom. The openings in each basin are usually made at the bottom and at opposite corners so that the fish must follow a zigzag path. This arrangement leaves one corner where the water is comparatively still where the fish can rest. This is necessary, especially for high weirs. The difference in elevation between basins regulates the velocity through the openings and should not be in

excess of about 18 inches. The slope of the fishway should not be steeper than one foot vertical to four horizontal. The width of the fishway is from 4 to 5 ft.; the baffles forming the basin are often placed on a 60 to 80 degree angle to the longitudinal axis so as to form trapezoidal basins. The average length of these basins is about 6 ft. and the depth of water from 2 to 4 ft. The minimum sized opening between basins should be 12 by 12. The fishway should be covered with a grating or screen to prevent interference, but the light must not be shut out or the fish will not use it. The design of fishways is illustrated by the accompanying drawings of fish ladders in the diversion dam of the Yakima-Sunnyside project and of the Payette-Boise project, Idaho.

Logway.

In those states where logging is practiced laws have been enacted making it necessary to provide for free navigation of streams for logging purposes. This requires ready means for passage of logs either over or through the dam. When overflow weirs are on streams carrying enough water to insure a sufficient depth of water over the crest at all times during the year, it will not be necessary to provide a logway, as the logs will pass directly over the main body of the weir. When the stream flow is not sufficient the flow may be largely confined to a smaller channel formed by the scouring sluices in front of the headgates and there may not be sufficient depth of water passing over the crest to carry the logs. For these conditions it is necessary to provide a logway.

The logway is generally formed by lowering the crest of the dam for a short section adjacent to the fish ladder and scouring sluice. The sides of the logway channel are formed by two walls running parallel with the direction of flow, one of which may be the side of the fishway or the abutment to the dam. In many cases to avoid an excessive waste of water it is desirable to build the logway as narrow as possible and the inlet is controlled by a gate which may be opened only when necessary. The width of the channel may be as small as 6 to 8 ft. and usually ranges from that up to 20 or 30 ft., depending on the amount of logging and water available. The sill of the logway is made at least 4 ft. lower than the crest of the weir. To guide the logs into the logway a timber boom starts from the head of the logway on a small angle with the direction of flow and extends upstream a distance sufficient to intercept the floating timber and guide it to the logway. The design of the logway is indicated in the above plan of the fish ladder in the Payette-Boise diversion weir.



Sluiceway in South Canal Dam, Salt River, Ariz.

DIFFERENTIAL RATES FOR ELECTRIC SERVICE.

A member of the Rate Research Committee of the National Electric Light Association has prepared a comprehensive argument as to why electric companies should adjust their rates so as to get all of the business possible. This will be published in its entirety in the forthcoming issue of the Bulletin, the conclusion being that differentials should be made enough in favor of large customers (and of certain uses, such as cooking, etc.) to get their business and that a single general rate should be made for the general public at least as low as would be obtained under free competition.

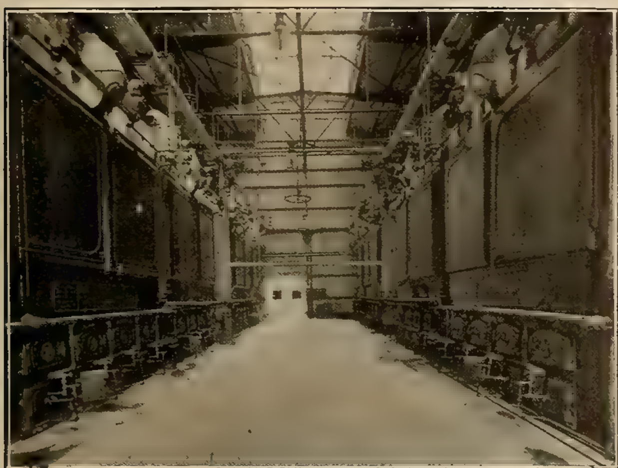
The company should adjust the rate to the various classes so as to get the greatest volume of business among which to divide joint costs, and in order to do this, first make sure that no class is supplied at a loss, and that each class bears as much as it can contribute (or would have paid under free competition) of the joint costs. This means make the rates proportional to the value of the service, less the savings due to monopoly.

ELEMENTS OF STEAM POWER PLANT DESIGN

BY C. H. DELANEY.[1]

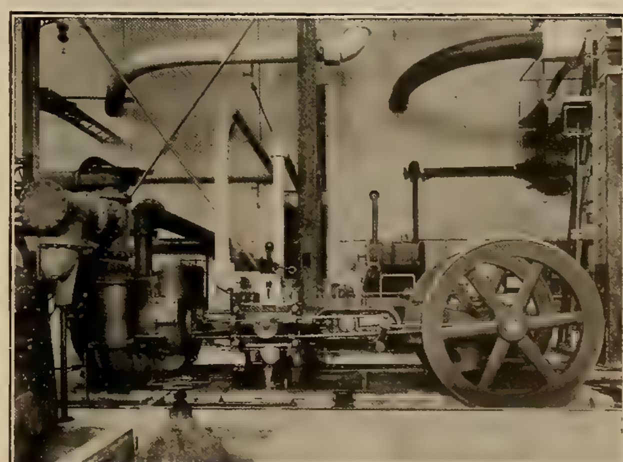
General Description. I.

I have been asked to discuss the subject of "Steam Auxiliaries to High Tension Transmission Systems." This title might as well have been written simply "Steam Power Plants," for the reason that a steam auxiliary to a transmission system is in fact a complete power plant having its full complement of boilers, engines, generators, condensers, pumps, etc., of sufficient capacity to generate enough electricity to supply the city or town in which it is located. In many cases the steam plant is not only large enough to furnish electric power for the city, but it is also used at times to transmit electric power back to the transmission system. This is especially the case at times when water is low in mountain lakes and reservoirs so that the water power generating stations are handicapped by lack of sufficient water and are compelled to call upon the steam plants to help them out. During the last few months this condition has existed with the Pacific Gas & Electric Company. Owing to the dry winter last year and the small amount of snow that fell in the mountains, the quantity of water available has been much less than is ordinarily the case at the end of the dry season, and for this reason more or less electric power has been transmitted every day from San Francisco and Oakland out to the country and smaller towns, instead of the power coming into the cities and supplying the city load.



Dry Vacuum Pump for 12,000 kw. Steam Turbine.

To enable this to be done it is necessary for a company to be provided with complete steam power plants, just as complete as if there was no high tension transmission system connected with them. The steam power plant consists essentially of two main divisions, the boiler room where steam is generated, and the engine room where the energy in the steam is converted into mechanical and electrical energy. The boiler room contains the boilers, furnaces, superheaters, economizers, smokestacks and all the auxiliary machinery necessary to operate them, such as feed pumps, fuel oil pumps, feed water heaters and oil heaters. In the case of a coal burning plant, the boiler room also contains the mechanical stokers, coal and ash handling machinery, and forced draft apparatus. On the Pacific Coast, however, where oil is used as fuel almost exclusively, these are eliminated. The engine room contains the prime mover and electric generator with their necessary auxiliaries. The prime mover is at present in almost every case a steam turbine instead of a reciprocating engine, as was formerly the case. The turbine, which may be either vertical or horizontal, is direct connected to an electric generator. In the case of a vertical turbine, the generator is placed above the turbine and the condenser which receives the steam after it has done its work in the turbine, is placed directly below the turbine. A number of auxiliary machines are required to operate the turbine. The principal ones are the pumps required to maintain the vacuum in the condenser. These are the wet vacuum pump which discharges the condensed steam from the condenser and delivers it back to the boiler room to be returned to the boilers; the dry vacuum pump which takes the non-condensable gases, such as air, which may have been dissolved in the feed water, out of the condenser; and the circulating pump which circulates the cooling water through the tubes of the condensers. In a large turbine installation the dry vacuum pump is itself a fair sized Corliss engine with fly wheel, valve gear and all the appurtenances required to make up a complete reciprocating pumping engine. The wet vacuum pumps are much smaller as they handle only the liquid, which does not expand as air does, in the rarified atmosphere of the condenser. They are usually of the centrifugal type, driven by either a small steam turbine or a motor. The circulating pump is also of the centrifugal type. It must be capable of handling large quantities of water—from fifty to seventy-five times as much as the wet vacuum pump—and is driven by either a compound engine, an electric motor or a steam turbine, depending on its location, the amount of steam available, and other minor considerations.

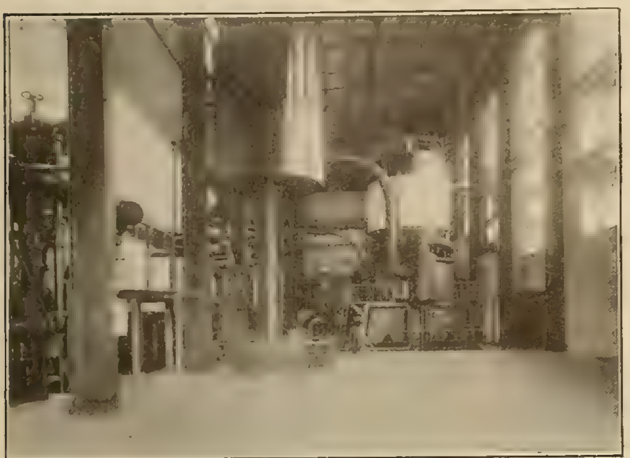


Typical Boiler Room Containing Eight 750 h.p. Water Tube Boilers, Installed in Oakland, Cal.

In addition to the foregoing, there are the oil

[1]Steam power plant expert in maintenance and operation department, Pacific Gas & Electric Company.

pumps for circulating the oil through the bearings of the turbine. In a vertical turbine installation there are two sets of these oil pumps, the middle bearing pumps which circulate oil at a moderate pressure through the upper and middle bearing of the machine, and the step bearing pumps which circulate oil at a very high pressure, 1000 lbs. to the sq. in., through the step bearing. The high pressure oil forces its



Engine Room Showing 12,000 kw. Vertical Steam Turbine, and Accumulator for Regulating the Step Bearing Oil Pressure.

way into the step bearing under the main shaft and has power enough to raise the whole shaft with its weight of all the revolving parts of both the turbine and the generator off its seat, so that while the turbine is in operation, the shaft is actually floating on a film of oil, not over two hundredths of an inch thick. A hydraulic accumulator is provided in the step bearing oil system to regulate the oil pressure and provide a certain amount of storage capacity to be used in case the step bearing pump should stop. This is provided with an automatic device which controls the operation of the pumps. If the pressure falls, the accumulator drops until it actuates a lever which opens a valve admitting more steam to the pumps. These at once speed up, increasing the oil pressure and causing the accumulator in turn to rise until the reverse action takes place and the pumps slow down again.

The auxiliaries required for the generator are the exciter, the transformers, and the switchboard with all its intricate wiring and costly instruments. It is a good practice to install a steam driven exciter for use in starting up and a motor generator for exciting the fields in regular operation.

All these machines have to be intimately connected together by means of piping. There is the high pressure piping connecting the boilers together and carrying the steam from the boilers to the turbine. There is the exhaust piping to carry the exhaust steam from all the auxiliary machines to the feed water heater and the feed piping to take the water from the feed water heater back to the boilers. There is also the circulating water piping which carries the circulating water from the bay or river through the condenser tubes and back to the place whence it came. Owing to the large quantity of circulating water required, these pipes are of necessity of large size, running from 42 in. to 60 in. in different plants, In many cases canals are provided for the inlet and outlet so as to bring the water supply close to the condenser. The pipes leading to and from the condenser are then very short so that the loss due to friction in these pipes is reduced to a minimum.

A steam power plant is not unlike a great manufacturing establishment where the raw material is gradually converted into the finished product. In the case of the power plant, the raw materials are fuel, air and water and the finished product is the electric energy delivered at the bus bars. The manufacturing process is a continuous one. There is a continuous flow of fuel oil from the storage tank to the furnaces. Here the fuel combines with the oxygen of the air generating the heat necessary to convert the water in the boiler into steam. The steam generated in the boiler flows through the superheater and steam pipe to the turbine and passes through the several stages of the latter where its energy is converted into mechanical motion. The final transformation takes place in the generator where the mechanical motion is converted into electric energy, which is continually drawn off as fast as required.

After this brief description of what the plant consists of, I will in the next issue take up the question of the design of the plant so far as the methods of determining the size of the various apparatus are concerned.

PROPOSED JOINT SURVEY OF POWER AT THE DALLES.

The Columbia River power site at The Dalles, Ore., offers a practical and powerful natural water power. The states of Washington and Oregon, and the United States, are urged by engineers who have examined the location to join in constructing a great dam at this point to supply power for all purposes. An appropriation of $150,000 is to be asked, this to be distributed one-third to each of the agencies of government.

It is proposed to build a dam 180 ft. in height, which is to shut out the waters of the Columbia at the Five Mile rapids and a canal 300 ft. in width and one and one-half miles long to the power house, which is to be built at Big Eddy. The river is to be channeled through solid rock 1400 ft. wide, which is to be controlled by a removable dam 70 ft. in height. This will create a fall one-half as high as that of Niagara Falls.

Six miles of the Celilo canal, which is now slowly advancing toward completion, will be completely drowned by this project, but the river raised in its stead, it is asserted, will improve navigation.

It is stated that 300,000 horsepower can be furnished twenty-four hours a day and 365 days in the year at a cost of $6.89 per horsepower.

In addition to this, 236,000 additional horsepower can be furnished for eight months of the year, making a total horsepower of over one-half million. The $6.89 per horsepower cost price is figured to include all maintenance, estimates and other charges, figuring interest at 4 per cent.

A plant erected at a cost of about $23,000,000 would be large enough to supply thirteen cities the size of Seattle today.

READINESS TO SERVE METHODS

HOW TO GET PROPER PUMPING INFORMATION.

BY ROSS B. MATEER.

"Tule" lands and peat islands protected from the tidewater and the floods of winter by the use of huge sand embankments are capable of intensive cultivation (1) by reason of fertile soil, (2) the judicious use of water. Both are essential for abundant crops and one has but to view the green lands—the islands of the Sacramento River—to gain convincing proof of their fertility and the profit assured by installing motor operated pumping units (1) for reclamation, (2) for irrigation.

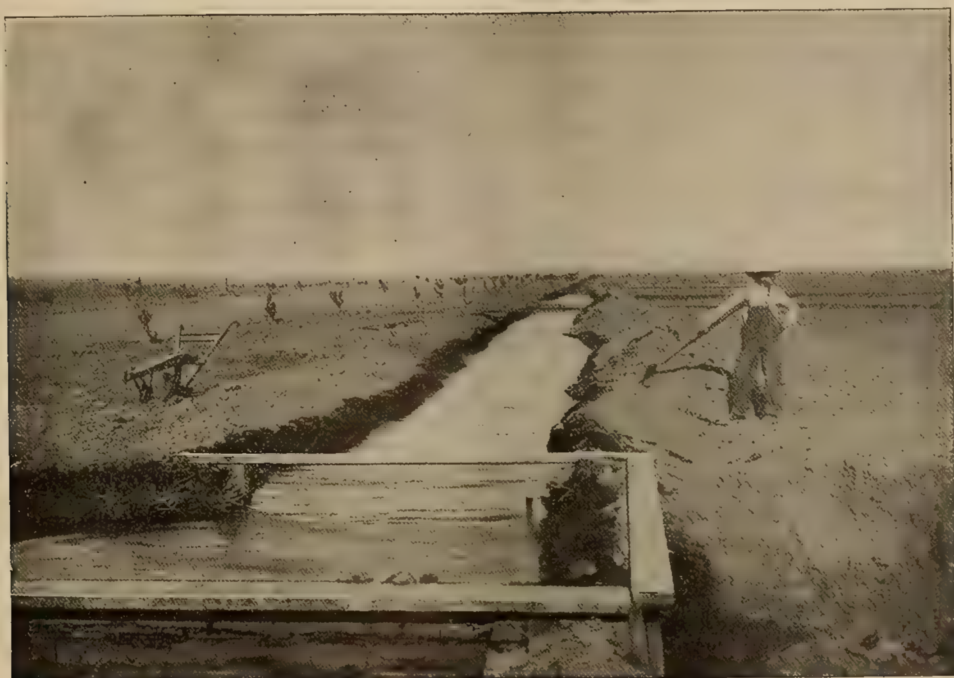
Pumping units may be constructed and utilized for either purpose but good practice dictates separate installations for each, combining the characteristics essential for economical and efficient operation.

To obtain the best operating conditions pumping apparatus is installed today with specifications prepared either by some disinterested engineer or by representatives of the manufacturer. Even inquiries should contain general information that the sales-engineer may quote comprehensively on the equipment best adapted, from superficial judgment, for the particular location and service desired.

Information Desired With Inquiries.

A series of fifteen questions, intelligently answered, permits of a tentative proposition on which exact data may be based. Those frequently asked of the land owner are prepared as below indicated:

1. Number of pumps wanted.
2. Gallons per minute or second feet wanted.
3. Is service to be continuous or intermittent?
4. What is the source of supply, lake, stream, ditch or well?
5. If a well, give description, including depth and inside diameter of well.
6. If well has been tested, give result, gallons per minute, distance that surface water recedes to when pumps ing, and distance when not pumping.
7. Is water to be pumped, clear, gritty, fresh, salt or acidulous?
8. How close to the water can pump set?
9. Give shortest lateral and vertical length suction pipe can be.
10. Give lateral distance and elevation in feet from the center of the pump to the point of discharge.
11. If either or both suction and discharge pipes are in place, give accurate description, including length, diameter, number and radius of bends.



The Irrigation Canal.

12. Type of pump wanted, whether horizontal, vertical, single, series, turbine or deep well.
13. Kind of driving power. If steam or gasoline engine, give power engine will deliver to the belt. Face and diameter of pulley, r.p.m.
14. If the pump is to be belted to an electric motor, give horsepower diameter and face of pulley, revolutions per minute.
15. If the pump is to be direct connected to electric motor, state if we are to furnish motor, and if current is to be alternating current. If so, give voltage, phase.

Specifications.

When the negotiations have developed to a point such as warrant exact data on the installation, its cost and conditinos governing the performance of the plant, articles of contract are prepared and when duly signed by both parties constitute an order. Such agreements are only complete when accompanied with drawings showing a cross section of the embankment and the approximate position of the apparatus.

Specifications that are a model for precision, and completeness, illustrative of an installation now under way are here quoted, sketch of levee being the same as that published last week in this department.

Specifications of a Pumping Plant.

Conditions and Proposals.

Attached hereto you will find section of the levee and proposed 10 in. pumping plant, together with a profile along the base of the levee inside of the fence line and the direction of the water flow in the alfalfa field.

From the section of the levee you will see that at this time there is a difference between the water in Steamboat Slough and the land on the inside of the levee of 4.5 ft., and that from the water to the top of the levee on the roadway the distance at this time is 21.7 ft. Providing that you cut down on the levee 5 ft. for your pipe line you would have a maximum pumping head to start the pump of 16.7 ft. A 10 in. pump has a capacity of 3000 gallons of water per minute. Using a 12-in. pipe line through the levee we have a friction head to overcome of 2 ft., making a total maximum pumping heat of 18.7 ft., which required 14.25 theoretical horsepower. Giving the pump an efficiency of 60 per cent, which is reasonable; we require 23.5 h.p. This is the power required under the present maximum conditions. Now providing that the discharge from the pump be lead into a sump filled with water, we gain the advantage of siphonage which will reduce the power required under the continuous pumping of irrigation 25 per cent. Thus the normal power required while you are irrigating will be approximately 18.5 h.p.

We suggest as the most satisfactory and adequate plant to deliver the 3000 gallons of water per minute, the one as illustrated in the sketch of the levee. This plant is designed to be installed on the inside of the levee because it is handier to have the pumping plant on the inside as it will be free from high water and inasmuch as the pumping plant can be so installed without any "U" suction bend in the suction line there is little or no advantage to be gained by placing it on the outside of the levee. We propose to install a 25 h.p., 1100 r.p.m. motor and a 10 in. pump, together with suction pipe as itemized in detail under "Details of Machinery." We have itemized the prizes for the different machines and work so that you will have a complete understanding of our bid.

Details of Machinery.

1-25 h.p., 1200 r.p.m., 220 volt, 60 cycle, 3-phase, a.c. electric motor	$309.00
Necessary change of motor-pulley, difference	5.50
Switch and fuses	5.00
40 ft. of 10 in. x 5 ply No. 1 rubber belt, $1.49 per ft., less 50 per cent	30.00
1-10 in. centrifugal pump fitted with suitable pulley and suction elbow, $400, less 40 per cent	240.00
Approximately 132 ft. of 12 in. No. 12 double rivetted, asphaltum dipped, caulked and chipped steel pipe. This pipe is to be flanged every 25 ft. and to be supplied with two bends so that it will be carried without undue bends into the levee. Price of pipe and rivetting flanges	160.20
7 sets of 12 in. cast iron flanges, together with the necessary bolts and gaskets, at $12.50 net	87.50
1-12 in. check valve, $75, less 30 per cent	52.50
1 large hand priming pump, valves, pipes and fittings, net	12.00
Approximately 42 ft. of 12 in. No. 12 double rivetted asphaltum dipped, caulked and chipped steel discharge pipe	46.80
2 sets of flanges, bolts and gaskets at $12.50 net	25.00
1 flange and blind flange for the end of discharge pipe to be put on in case of high water in river	12.50
Total cost of machinery, pipe, valves and fittings	$986.00

Freight and Haulage.

We will deliver all the machinery and supplies at the steamer at San Francisco. You to pay the freight and to haul the machinery to the place of installation.

Foundations.

We will supply the necessary rock and gravel for the foundations under the pump and motor for the sum of Twenty-five ($25.00) Dollars.

Installation.

We will construct the foundations, install the plant in a first-class and workmanlike manner. You to make the necessary excavations and fill in the levees and to supply the helper to our installing engineer, Having installed the plant we will operate same for a period of 10 hours to show that it successfully fulfills the conditions given previously. The cost of this installation will be Fifty ($50.00) Dollars.

Sump.

You are to construct the sump to gain the benefit of siphonage and we will supply you drawings and material dimensions for same.

Price.

The price of the entire plant as itemized above will be One Thousand Sixty-one ($1061.00) Dollars.

Terms.

The terms of payment of this plant to be cash upon the installation as above described and demonstration after a ten (10) hour test that we have fulfilled this contract as hereinbefore specified.

Plant No. 2.

This proposition is to fix up the present 15 in. siphon line and 8 in. pump; to drive it by a motor. The difference between the water as it now stands and the surface of the ground is 6.8 ft. with approximately no friction in the siphon line when delivering the capacity of an 8 in. pump, 1600 gallons of water per minute. Therefore we propose to supply you with one 10 h.p., 1120 r.p.m., three-phase, 60 cycle, a.c. motor, $203. Suitable change of pulley, difference, $5.50. Switches, $5.00. This makes a total of $213.50 for the machinery required. We suggest that you use the taper you now have on hand, the 10 in. suction pipe, 8 in. pump; 10 in. discharge pipe and belt. The work of installing this plant can be done by yourself under the supervision of our installing engineer, for which there will be no charge providing the work is done at the same time that the other work is being installed.

General Conclusions.

Specifications of this character are a result of a thorough investigation of the conditions under which the equipment must operate and insure a proper and efficient installation, satisfactory both as to material used in the construction as well as the cost of operation. Each proposition is then a problem, the correct solution of which is a guarantee of satisfaction. More attention should be given to the proper equipment and its installation, than to its operation as the first two features insure the latter.

The variation in price between the high and low bid may be considerable, yet seldom warrants the granting of the contract to that firm whose low figure is their qualification. The best material, its proper installation, superintendence and reasonable profit are the cause of the larger figure and are worthy of such attention as to frequently result in the elimination of all low bids. Experience demonstrates the fact that extremely low figures are not the natural result of clean competition but the elimination of items as before mentioned. Mechanical lift of water by electric power is not experimental but a necessity and the convenience warrants an installation that is satisfactory, not for this year only but that will possess the qualities of economy, efficiency and durability.

TRANSFORMER CONNECTIONS.

BY W. A. HILLEBRAND AND E. R. SHEPARD.

(Continued.)

Star Primary, Star Secondary.

Various arrangements are shown in Figs. 10, 11 and 12. Of these, 10 and 11 are feasible, but Fig. 10 requires unusual voltage ratings for either lamps or motors. The connection in Fig. 12 is not practicable, because any unbalanced single phase current drawn by, for instance, transformer No. 1, must, in the primary, pass through 2 and 3, which now act as choke coils, distorting the voltages to neutral with possible

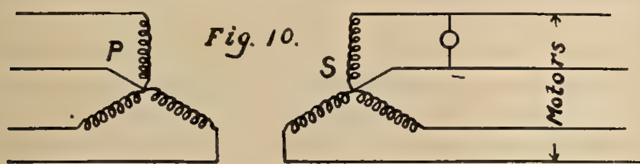


Fig. 10.

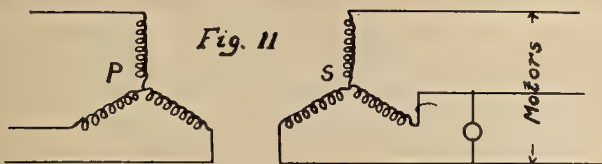


Fig. 11

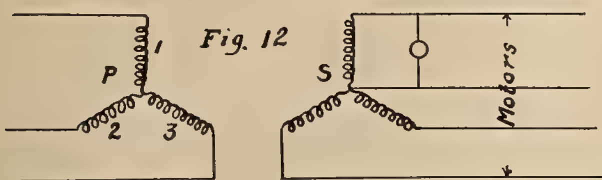


Fig. 12

breakdown of the lightly loaded transformers, due to excessive voltage and core loss. This connection is essentially that of Fig. 5.

Using the connection of Fig. 11, even with balanced load, the voltages across each transformer may be over 15 per cent larger than the ideal proportion of 57.8 per cent of the delta e.m.f., due to the introduction of a third harmonic by the star connection. The core losses would also probably be increased, though to what extent it is difficult to say since the e.m.f. and flux waves are no longer simusoidal.

Star Primary, Delta Secondary.

Under ideal conditions an extremely satisfactory service is obtained with the connection of Fig. 13, with primary neutral grounded at power house or substation and on all transformer banks. Then any unbalanced current is drawn chiefly through the loaded transformer and at the power factor of the load.

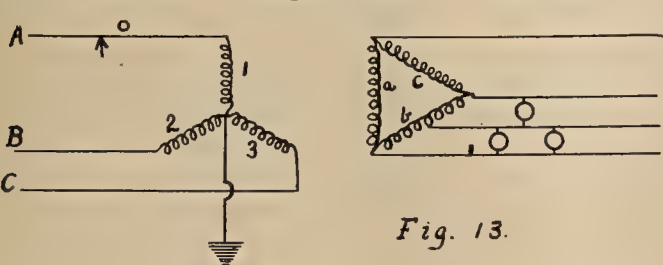


Fig. 13.

However, this arrangement has one drawback which, in an extensive system, practically forbids its adoption. If the primary line grounds on any feeder is constitutes a short circuit in both directions for the entire system. For instance, assume a ground at "O," Fig. 13. Transformers 2 and 3 are still supplied with normal pressure, and through their secondaries, b and c, maintain normal pressure on transformer No. 1, feeding the short circuit from both directions and constituting a short on all three phases. This applies to all transformer banks connected to the same feeder or on feeders leading from the same bus, so that after such a ground many installations in the entire territory served are out of commission until the primary fuses have been replaced.

To obviate this difficulty the ground connection must be removed. Any unbalanced current due to single phase loading must, in the primary, flow through the other two transformers equally, as in Fig. 12. The secondaries of these transformers, a and c of Fig. 13, are now in parallel with the loaded transformer, and the excess primary ampere turns in each maintain voltage sufficient to supply current to the load. The unbalanced current in two transformers, as a and c, Fig. 13, will be half of that in the loaded transformer.

Delta Primary, Delta Secondary.

For distribution voltages of moderate range and limited radius, where the self-induction and capacity of feeders are not too great, this is perhaps the most serviceable transformation. On high voltage systems of considerable length, comparable to that of many high-power transmissions, a ground on an isolated delta causes high frequency oscillations of the natural periodicity of the system with resonant rises of potential which have been known to shatter insulators and interrupt service.

Three-Phase to Two-Phase Transformations.

This is illustrated in Fig. 14.

With balanced non-inductive loading the currents in the two branches, a o and b o, are out of phase with the e.m.f a b by 30 degrees, leading in one-half

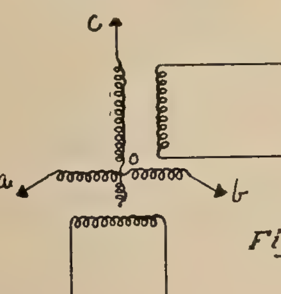


Fig. 14

of the transformer and lagging in the other half. The two transformers may be loaded to 93 per cent of their combined capacity without overloading transformer a b. The losses in transformer c o are somewhat less than normal, due to fact that only 87 per cent of one winding is used.

Owing to the fact that the power factors of the currents in the two halves of transformer a b are not alike, these two sections will regulate differently, with consequent unbalancing under load, which unbalancing will not be serious if the transformer is provided with a sufficient number of coils on the side connected to the three-phase line so that there may be proper interlacing. If, however, coil a o is wound on one leg and b o on the other of a core type transformer, then, due to excessive magnetic leakage, the unbalancing may be prohibitive.

(To be continued.)

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Utility Service at Riverside

The city of Riverside, in Southern California, has worked out its own salvation, so far as street lighting is concerned, in a remarkably artistic manner. This beautiful tropical district so rich in the lore and traditions of the early Spanish adventurer and priest, has not overlooked the possibility of carrying out the decoration of its principal streets in fitting compliance with this early life. Posts of cement with three lights appearing as bells in mission cloisters, surmounted with a cross as described elsewhere in this issue, are thus seen to have an aesthetic value of high order.

In the distribution of service to customers this city, too, has evolutionized ideas of lamp renewals fully in accord with the latest central station practice. It will be interesting to briefly summarize the mode of procedure here instituted. First the lamps, carbon filament and tungsten, are sold to customers as near cost as is possible to compute. All lamps thus sold by the city are renewed, free of charge, in sizes from 20 watts to 500 watts. The customer, himself, must, however, bring the lamp to the city office to get the renewals. In November, 1912, lamp renewals amounted to a valuation of about $500, practically evenly divided between the old carbon filament and the tungsten lamp. A close study of individual customer's accounts indicates that even though the tungsten has per unit reduced the power consumed by enormous proportions, still practically no variation in the monthly bill is observed, for the customer has now found more uses for electric power consumption than he formerly entertained.

There are still many problems of decorating features suitable to advertise the individuality of a municipality yet to be worked out. Moreover lamp renewals and proper relations with the public must still be unsolved problems for future years to unfold. Nevertheless, ideas of progress and evolution in the small network, such as the Riverside installation, serve to substantially record such progress from time to time and often the newcomer forms his impressions as to the progressiveness of a community by observing the intelligence and taste shown in its street lighting effects.

The A. I. E. E. Executive Committee vs. The Section

President Mershon of the American Institute of Electrical Engineers in a recent after-dinner speech very properly cautioned the local sections in regard to their taking action upon matters clearly prescribed in the constitution of the Institute as functions of the general Board of Directors or Executive Committee. He called attention to the fact that on a previous occasion the executive committee, having properly passed upon an important matter, were considerably embarrassed by finding that a subsequent action was taken by a section of the Institute, in direct hors de combat with the action of the general body. Such an incident is most unfortunate to say the least and clearly evidences the necessity of a word of caution from the chief executive of the Institute.

Some were prone to misinterpret Mr. Mershon's remarks on this subject as being a possible hint that

centralization of powers in the New York body would be attempted, thereby curtailing the usefulness of the section as a forum for debate on all questions of vital interest to the body at large. Such a misinterpretation is not only unwarranted but is successfully refuted by noting the broad gauge manner in which recent presidents and governing bodies of the Institute have conducted its affairs.

The constitution of the American Institute of Electrical Engineers clearly defines the duties of the Board of Directors, the highest governing body in the Institute, as pertaining largely to the appropriation of moneys, applications for admission and transfer, appointing of employes and fixing their salaries and in general to direct the business of the Institute. The rapid and widespread growth of the Institute is largely due to the recent broad policies inaugurated by recent governing boards. So long as the membership at large feel that such is the national policy, so long will the national organization continue to exert its helpful, invigorating influence. It would seem, then, that in the affairs of the Institute the utmost freedom of discussion throughout the length and breadth of its membership should be had on all subjects except those clearly delegated by the constitution to the governing board.

Proposed Diversion of Tahoe Lakes

Riparian rights and the value of Lake Tahoe as a scenic asset of California are at present seemingly arrayed against a project to utilize the waters of this lake for power and irrigation purposes in the State of Nevada. Engineers of the reclamation service propose to keep the raising and lowering of the lake within a range of six ft., while the property owners argue that a greater fluctuation than four ft. would cause damages amounting to millions of dollars, not alone due to the resulting depreciation of the lakeside as a natural scenic resort but also due to the damage to heavy investments in some sixteen resorts now located there. The lake has a surface of 192 square miles or 125,000 acres. Thus a two-foot dispute means the possibility of cutting off forever the irrigation of at least 50,000 acres of arid lands.

The Secretary of the Interior has appointed an eminent engineer and a well-known agriculturist to act as commissioners and ascertain the exact status of affairs in the controversy. The secretary and his commissioners may well weigh the final verdict with the utmost caution. It is a subject of far reaching importance to the arid West.

The diversion of waters from one state into another should be handled along the broadest possible lines to accomplish maximum development and usefulness of Western natural resources. By glancing through a digest of court decisions covering the question at issue it becomes evident at once that states may forbid by legislative action the taking of waters into other states where such waters do not naturally find their way into the foreign territory. Without such legislation, however, waters may be conducted from the state. In 1911 California enacted legislation making it unlawful to transport the waters of any lake or stream of the state into any other state for use therein. The enactment of the California law was to say the least a narrow-minded policy. The highest utilization of water knows no such limits as a state boundary, fixed alone by the whims and fancies of political evolution.

In 1901, the state of Kansas initiated a suit against the state of Colorado charging the latter commonwealth with wrongful diversion of the waters of the Arkansas River. The Supreme Court of the United States finally ruled that the uses of the waters of the Arkansas, which flow from Colorado into Kansas, must be so adjusted upon the basis of equality of rights as to secure as far as possible to Colorado the benefits of irrigation without depriving Kansas of the like beneficial effects of a flowing stream.

Hence it would seem to all broad-minded citizens that the present controversy over the Tahoe waters should be settled along similarly constructive lines, irrespective of a law which would harass ultimate development of Western arid lands. Many claim that the law of 1911 does not apply in the case at issue. If it should be ruled to apply the law might well be repealed.

This instance is illustrative of hundreds of other similar possibilities throughout the West. Whether or not the Secretary of the Interior, the state legislatures, the state engineer or a water commission has real jurisdiction in the matter, in any event, certainly an opportunity is offered in every such case for constructive ideas, wholly without a peer in almost any other problem now before the West.

The Steam Auxiliary

Fully as active as the hydroelectric development in the West, has been that of its twin sister—the steam auxiliary. Within the year just completed scarcely a large metropolitan district has been passed without kindly and costly additions being made in this important branch of central station economics. This growth has been so extensive and the size of units so wholly different from former practice that the designing engineer has at hand little published data to aid him in choice of his equipment. Search, if you will, even the proceedings of our national engineering societies, and little is to be found on Pacific Coast practice relating to steam auxilary evolution.

On another page of this issue will be found the beginning of an important series of six papers on the elements of steam power plant design. The author, Mr. Chas. Delaney, will set forth in this series much matter, hitherto unpublished, which will prove indispensable to the central station engineer in proportioning the various parts of his steam equipment. The boilers and their sizes, the condensers and their auxiliaries, and the prime mover with its countless niceties, will all be explained so far as their general relationship one with the other is concerned. The searcher will thus find new ideas in power plant apportionment, helpful in every detail.

Mr. Delaney speaks from a wealth of information acquired first as an undergraduate of a Western university and later in graduate investigation at Cornell. Years of practical experience in the testing department of the Babcock & Wilcox Boiler Works fully fitted him for his present position as a power plant expert.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Geo. R. Murphy of the Electric Storage Battery Company is at Salt Lake City.

F. O. Sievers, sales engineer with the Fort Wayne Electric Works, is at Los Angeles.

E. G. Dewald, hydraulic expert with Pierson Roeding & Co., has returned to San Francisco from the East.

W. W. Lowe of the Electric Appliance Company at Chicago, is to be an attendant at the coming Jobbers' Convention.

F. L. McGillan, formerly with the California Pole & Piling Co., recently took charge of the pole department of Pierson, Roeding & Co.

H. V. Carter, president of the Pacific States Electric Company, returned last Thursday from an extended and very successful trip through the Northwest.

H. C. Goldrick, Pacific Coast sales manager for the Kellogg Switchboard & Supply Co., has returned to San Francisco from a trip throughout the Pacific Northwest.

J. E. Hascke, inventor of the Hascke storage battery and electric automobile parts, is at San Francisco, where it is possible that a manufacturing plant will be established.

N. H. Silver has succeeded **B. B. Beckett,** resigned, as manager of the Seattle office of Pierson, Roeding & Company. Mr. Beckett continues his electrical engineering practice.

W. S. Cone, former division manager at Sacramento, has been appointed manager of the eastern division of the Great Western Power Company with headquarters at Oakland.

A. L. Menzin of San Francisco has been appointed engineer for the Edgemoor Iron Works and left this week for Wilmington, Del., where he will hereafter make his headquarters.

Norton L. Taylor, of Tacoma, Wash., has been appointed special engineer to check up the construction work on the pole line of the Nisqually Power Plant, from La Grande to the Tacoma sub-station.

A. C. Haggenmiller, of the Washington Water Power Company, has assumed the duties of Statesman for the Jovian Order at Spokane. **C. R. Bean,** the former Statesman, having recently gone to Portland.

F. D. Nims, electrical engineer with the Western Canada Power Company at Vancouver, B. C., and chairman of the Vancouver Section of the American Institute of Electrical Engineers, is visiting the various Pacific Coast sections and making arrangements for the Coast meeting of the Institute which will be held at Vancouver, September 9-11, 1913. He is now at Salt Lake City.

W. L. Goodwin, manager of the Pacific States Electric Company, announces the appointment of W. F. Rawdon, F. B. Nightingale and T. H. Nelmes to the sales forces of their Portland, Los Angeles and San Francisco houses. Messrs. Rawdon and Nightingale expect to leave for their respective fields the latter part of the week. Mr. Goodwin, together with D. E. Harris, expect to join the party, leaving for Lake Spaulding about February 21st.

John C. Corbin, consulting mechanical engineer at Seattle, has been elected president of the Seattle Engineers' Club. **G. B. Harrington,** assistant general superintendent of the Seattle Division of the Puget Sound Traction, Light & Power Co., has been elected vice-president. **J. Thomas Dovey,** of the Seattle Engineering Co., is secretary and **Robert Howes.** consulting electrical engineer, is treasurer. Weekly luncheons are held at the College Club on Thursdays.

MEETING NOTICES.

Portland Jovians.

The Jovian Order at Portland gave a dinner in honor of Reigning Jupiter Frank E. Watts at the Imperial Hotel, February 1, 1913.

Electrical contrivances of many kinds contributed uniqueness to the entertainment. As the soup was served the room became dark and a huge red devil, patron of the organization, sprang into brilliant relief before startled eyes. F. W. Hild, as toastmaster, called upon one after another for comments. Mr. Watts urged more activity in propagating the co-operative principle, especially in the West, where power, mostly undeveloped, abounds. For the future he predicted a strength to the order and influence of its pronouncements excelled by none.

George R. Sailor, Statesman for Oregon, enumerated the propositions which the order has been working for, including the electrical contractors' license law, the agricultural extension measure, and the Celilo and Deschutes power development measures.

At the dinner in honor of Mr. Watts there were present: F. A. Barnicott, F. N. Simonton, Paul Maloney, G. Bump, A. B. Vander Wicken, A. H. Wahl, Burton R. Stare, C. R. Dederick, H. T. Van Riper, J. R. Wood, E. L. Van Dresser, C. J. Franklin, Horace S. Clark, A. C. McMicken, M. E. Connor, A. M. Wilson, W. E. Coman, A. E. Watts, F. W. Hild, George R. Sailor, J. E. Davidson, G. N. Barker, Russel K. Akin, L. T. Merwin, F. L. Whipple, L. M. Sherman, C. E. Condit, Burnett Goodwin, L. G. Fear, W. E. Peters, C. P. Potter, F. H. Smith, A. V. Olson, C. M. Wright, H. B. Rogers, A. L. Sailor, S. C. Jaggar, Wilfred L. Ingalls, William F. McKenney, W. C. Campbell, F. E. Meyers, E. W. Bonness, J. L. Thatcher, R. S. Fisher, H. R. Wakeman, W. B. Foshay, E. S. Whitney, H. Wells, J. L. Priest, I. N. Chamberlain, F. N. Averill, J. T. Ryan, R. G. Littler, R. F. Monges, C. P. Osborne, Edward A. West.

Oregon Technical Club.

The regular Tuesday luncheon at the Portland Grill was addressed by President Campbell of the University of Oregon, on "Future of Technical Education in Oregon." The presiding chairman being E. B. Thompson of the U. S. Engineer's office of Portland.

Mr. Campbell said in part: "In ten years the high school giving a four-year course have increased from 4 to 125."

"'The Entrance' requirement for the University of Oregon, into the Engineering Colleges, is 15 units of preparatory work." In relative division of the courses in the college course for the various branches of engineering as regards professional culture and liberal culture are as follows:

	Prof. Culture.	Liberal Culture.
Civil Engineering	2/3	1/3
Electrical Engineering	7/8	1/8
Railway Engineering	2/3	1/3
Sanitary Engineering	2/3	1/3

The University Extension work this year includes extension work in Engineering. The total enrollment in extension work is 400. The heads or assistants of the different departments, in ertension work visit these students outside the university about once in two weeks.

Mr. Campbell laid great stress upon the fact that engineering was getting to be differentiated into two branches—Industrial and Professional—which demanded different training and answered different callings.

He said that he desired suggestions from the Oregon Technical Club as regards the framing of a five or six-year course for engineers so as to include more general culture work, also to differentiate the public mind as regards industrial and professional engineering, and some systematic

basis on which to base the various degrees given for engineering work.

A motion was made and passed "That each organization represented in the Oregon Technical Club, appoint one member of their respective organizations, to represent them on a general legislative committee which is to co-operate with the educational institutions of the state, in order to further legislation which would promote the interests of technical education."

The subject for the next luncheon will be "Pertinent Legislation," and the American Institute of Architects will have charge.

Portland Section A. I. E. E.

The regular monthly meeting of the Portland Section of the A. I. E. E. will be held Tuesday evening, the 18th of February, in the club rooms of the Oregon Technical Club, at 247½ Stark street. A paper will be presented by Mr. L. W. Haller on "An Electrolytic Survey of a Small City."

A CO-OPERATIVE PLAN TO DEVELOP THE ELECTRICAL INDUSTRY.

Probably one of the most purposeful and important meetings that has ever been arranged for in the electrical industry, is that which has been announced by the Board of Directors of the Society for Electrical Development, Inc., for March 4 and 5, in the Engineering Societies Building, 29 W. Thirty-Ninth Street, New York City, to which the entire electrical fraternity, as well as the general magazine men, advertising agencies, etc., are invited.

The object of the meeting is to obtain from as many angles as possible, the various ideas of the many branches of the industry on the tentative plans that will be proposed in a most comprehensive program that will include papers and suggestions invited from, or promised, by such men as Henry L. Doherty, Joseph B. McCall, Dr. Talcott Williams, Thomas Commerford Martin, F. H. Gale, Reginald Pelham Bolton, George Harvey, William D. McJunkin, J. M. Wakeman, Hugh Chalmers, W. E. Robertson, A. W. Burchard, L. A. Osborne, J. C. McQuiston, and others.

Among the plans suggested will be that for a broad educational general magazine and class paper advertising campaign, together with plans for a comprehensive press bureau for the dissemination of news matter pertaining to things electrical and also a field department for co-operative and general educational work throughout the electrical and allied industries, architects, building trades and various manufacturing fields.

The Board of Directors of the Society, as an Organization Committee, have, of course, discussed and formulated divers concrete plans, but as the active work of the Society will effect practically every individual interested in the electrical business, it was thought that only by a broad discussion of the definite policy of the many lines of effort which the Society will endeavor to accomplish, could a plan be arrived at that would coincide with the thoughts of the many diverse but allied interests involved.

Considered as an infant, the electrical business has in something less than forty years, shown a wonderful development—a development that has probably never been equaled by any other industry, not even considering steam and gas.

Recent figures show that something over $10,000,000,000 is invested in the business, with gross earnings of something over $40,000,000 annually, in this country alone, from one branch—the central station industry. The total American annual expenditure on electrical service, apparatus and supplies, is in excess of $2,000,000,000, but should double that easily.

It is said that approximately 5 per cent of the total population of the United States gets his or her living more or less directly from electricity and its ramifications, and that fully 40 per cent of the aforesaid population uses electricity in some form or other every day, if only by the sending of a telegram, the use of the telephone, hopping on a street car, or pushing a door bell. And this enormous business growth can practically be said to have developed itself; for it is only in the last half dozen years that a few of the larger central stations and manufacturers have made any real effort toward educating the public to the use of what is still a stupendous mystery to the average layman. A brief glance at some of the selling and advertising statistics given in the December issue of the "Efficiency Magazine," statistics collected from many industries, show an advertising expenditure of from 1 to 2 per cent in the electrical business, as against 2 to 66 per cent in promoting other industries.

If this be true of advertising, it is only fair to assume that expenditures along other lines of salesmanship are relatively the same, and if the experience of these other industries is of any value, it would seem that electrical men are far behind as business developers when opportunities for expansion are considered. Will the industry allow, year after year, a consequent loss of business through lack of selling effort, or combine forces through the opportunity offered by the plans of the Society and carry out in the near future a series of campaigns which, under the direction of the representative men, who are giving a large portion of their individual time and energy to the movement, must be of an efficient and beneficial nature to the entire industry.

The plan as presented is so sane, so logical and so businesslike in its complete aspects, that it seems to have for its future, all of the many essential elements which make for success, and in the carrying out of the plans, there can be very little question, but that each individual member will profit from the small individual subscriptions, many dollars from each invested.

A complete program of the conference will be published in the near future, and as the policy and plans of the Society are of the utmost importance to the individual interests of all, a large attendance of the influential men of the industry is expected.

SAN FRANCISCO ELECTRICAL DEVELOPMENT LEAGUE.

The monthly meeting of the Electrical Development League of San Francisco, was held February 11, some 65 members being present. Proposed amendments to the League's constitution, enabling an affiliation of the Jovian Club with the League, as submitted by the special committee to consider the matter, were adopted, and final action will be taken at a special meeting to be called February 25.

The Golden Poppy Special Committee reports much interest and enthusiasm being taken in the organization of the special train party from the Pacific Coast to the N. E. L. A. Convention at Chicago, in June next. Already many have indicated their intention of joining the special train party.

A communication from Phil Dodd, of the Society for Electrical Development, New York, told of a conference to be held by the Board of Directors of that organization the early part of March, at which the League was requested to be represented, for the purpose of discussing ways and means of furthering the electrical industry throughout the United States. It is quite likely the Pacific Coast will be represented at this important gathering.

The speaker of the day, Mr. J. J. Tynan, Superintendent of the Union Iron Works, was unavoidably detained from the meeting, but sent Mr. R. H. Postlewaite, manager of the Mining Department, as his representative, who read a most interesting paper on "Manufacturing Conditions in San Francisco."

THE ELECTRICAL CONTRACTORS' DEPARTMENT

STANDARD SPECIFICATIONS FOR WIRING BUILDINGS.

The Portland Railway, Light & Power Company has submitted to the architects of Portland some valuable data and suggested specifications on wiring buildings in the hope that they may be of assistance in drawing up lighting plans and specifications. The company suggests that it is advisable when erecting a building to have it wired with sufficient capacity to provide for all probable future requirements. Although the first tenant may only want to use one watt per square foot of floor area, the next one may want to use 2 watts, and for that reason, the wiring should be of sufficient capacity to supply 2 watts per sq. ft. of floor area.

A schedule is given below showing the number of watts per sq. ft. of floor area being used in various stores in Portland.

	Kind of 'amps used	Watts per sq ft.
Butcher Shop, 1st and Alder	Tungsten	2.00
Meat Company, 1st and Alder	Tungsten	1.37
Concordia Club—Ladies' Room	Nernst	5.00
Oregon Hotel Lobby and Office	Gem and tungsten	1.72
Portland Hotel Dining Room	Gem	2.35
Restaurant, 146 5th St.	Tungsten	1.33
Restaurant, 305 Washington	Gem and tungsten	2.50
Restaurant, 311 Washington	Gem and tungsten	2.20
Saloon, 143 3d St.	Tungsten	1.78
Saloon, 122 4th St.	Gem and tungsten	1.36
Saloon, 5th and Washington	Gem and tungsten	2.20
Saloon, 309 Washington	Gem	2.22
Confectionery, 273 Morrison	Gem and tungsten	1.56
Confectionery, 274 Washington	Tungsten	2.70
Cigar Store, 141 3d St.	Tungsten	3.40
Cigar Store, 3d and Washington	Tungsten	3.45
Cigar Store, 4th and Washington	Tungsten	2.00
Cigar Store, 5th and Washington	Tungsten	4.68
Cigar Store, 5th and Washington	Tungsten	2.45
Cigar Store, 7th and Washington	Tungsten	3.30
Cigar Store, 364 Washington	Tungsten and Nernst	2.00
Cigar Store, 147 3d St.	Tungsten	2.40
Cigar Store, 286 Washington	Tungsten	2.30
Clothing Co., 289 Washington	Tungsten & elect. arcs	2.62
Clothing Co., 329 Washington	Tungsten	2.00
Clothing Co., 166 3d St.	Tungsten	2.50
Clothing Co., 1st and Morrison	Tungsten	2.00
Clothing Store, 4th and Morrison	Elect. arcs	1.63
Clothing Co., 241 Morrison	Tungsten	3.14
Drug Co., 151 3d St.	Tungsten and Gem	2.90
Drug Co., 4th and Washington	Tungsten and Gem	1.42
Drug Co., 7th and Washington	Tungsten	2.45
Fur Co., 334 Washington	Tungsten	2.70
Hardware, 305½ Washington	Tungsten	1.45
Hardware, 345 Wasnington	Tungsten & elect. arcs	2.00
Jewelry Co., 1st and Washington	Tungsten	2.30
Jewelry Co., 268 Washington	Tungsten	2.50
Jewelry Co., 272 Washington	Tungsten	2.57
Jewelry Co., 294 Washington	Tungsten	3.80
Jewelry Co., 307 Washington	Tungsten	2.50
Jewelry Co., 283 Washington	Tungsten	1.25
Belding Bros. & Co., 345½ Wash.	Tungsten	3.85
Shoe Store, 7th and Washington	Nernst	1.53
E. P. Charlton, 288 Washington	Tungsten	2.57

Show window illumination cannot be figured in terms of watts per sq. ft. but can be figured in terms of watts per lineal foot of window.

Following is a list showing number of watts being used per foot, the size of lamps, and the distance between lamps in four stores in Portland:

	Watts per lineal ft.	Size of tungsten lamps.	Distance between lamps.
Ben Selling, 4th and Morrison	40 watts	40 watt	1 ft.
R. M. Gray, 4th and Morrison	40 watts	40 watt	1 ft.
Sam'l Rosenblatt, 3d and Morrison	40 watts	60 watt	1½ ft.
Olds, Wortman & King	50 watts	100 watt	2 ft.

Following is an example showing how the "watts per sq. ft." shown in the upper schedule were obtained:

The example: Clothing store, 286 Washington street; size of store 15 ft. x 36 ft., equals 540 sq. ft. Number and size of lamps:

5-100 watt tungsten equals	500 watts
3-250 watt tungsten equals	750 watts
Total watts equals	1250 watts

Dividing total watts by floor space area, we have 1250 watts divided by 540 sq. ft., equals 2.3 watts per sq. ft.

Since most storekeepers wish to use either one 150 watt or one 250 watt tungsten lamp on each outlet, it is wise to provide outlets of that capacity.

To find number of outlets required, first decide how many watts per sq. ft. and how many watts per outlet you wish to provide, then use the following formula.

$$\text{Number of outlets equal} \frac{(\text{floor area}) \times (\text{watts per sq. ft.})}{\text{watts per outlet.}}$$

A 16 candle-power lamp takes 50 watts and since it is customary to indicate the capacity of electric outlets on plans by showing the number of 16 candle-power lamps that each outlet is to be wired for, divide the number of watts per outlet by 50 watts to find the number of 16 candle-power lamps per outlet.

Therefore an outlet which is to have sufficient capacity for a 150 watt lamp should have the numeral "3" written beside the outlet character, and one which is to have capacity for a 250 watt lamp, should have "5" written beside the character.

Candle power and Current Consumed by Various Lamps in Common Use in Portland in 1911.

Nominal Designation.	Candle-power.	Watts consumed.	Candle-power.
16 candle-power	16	50	3.1
No. 1 Gem	20	50	2.5
No. 3 Gem	50	125	2.5
No. 4 Gem	75	187	2.5
No. 5 Gem	100	250	2.5
40 watt tungsten or Mazda	32	40	1.25
60 watt tungsten or Mazda	48	60	1.25
100 watt tungsten or Mazda	80	100	1.25
150 watt tungsten or Mazda	120	150	1.25
250 watt tungsten or Mazda	200	250	1.25
Enclosed arc (approx.)	450	600	1.33
Intensified arc (approx.)	450	600	1.33
		In Series	
Flaming arc (approx.)	1000	500	.5
		In Multiple	
Flaming arc (approx.)	1000	1000	1.0

N. B.—Candle-power ratings of arc lamps in this schedule are based on their illuminating values, as compared with tungsten lamps.

Note:—The lamp commonly termed "16 c.p." as at present furnished by the P. R. L. & P. Co. is in reality a 20 c.p. G.E.M. lamp.

(To be continued.)

TRADE NOTES.

The Bryant Electric Company, and The Perkins Electric Switch Manufacturing Company announce the removal of their San Francisco offices and warehouses to the second floor of the Greenwood Block, 149 New Montgomery street.

The Salt Lake & Ogden Railway Co., Salt Lake City, Utah, will add to its rolling stock equipment, nine G.-E.-205, 100 h. p., four-motor car equipments, with Sprague-General Electric type "M" multiple unit control. The General Electric Company will supply the apparatus and make the installation.

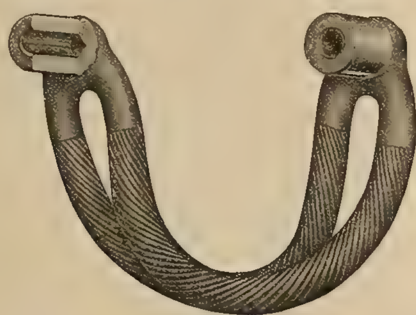
The Great Northern Railway Co., St. Paul, Minn., recently bought two gas-electric motor cars from the General Electric Company. These will be of the large 70-ft. type, and will be placed in service on the branch line of the Great Northern System running between Rockport and Anacortes, Wash.

The Spaulding Building in Portland, Oregon, is installing an independent electric plant. It consists of two 75 kw., 100-220 volts, d. c., 3-wire generators directly coupled to two engines. The generators are being furnished by the Triumph Electric Company of Cincinnati Ohio and the engines by the Lyconing Engine Company.

INDUSTRIAL

A NEW RAIL BOND.

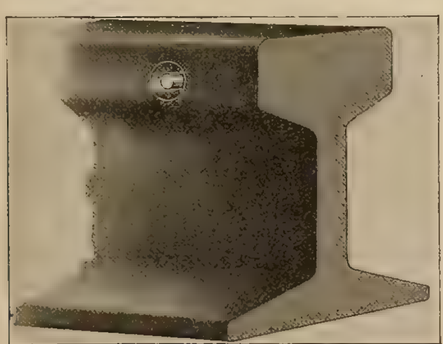
An entirely new method of securing contact is used in a bond just placed on the market by the Ohio Brass Company of Mansfield, Ohio, and known as their Type J all-wire rail bond. Reference to the illustrations will show the novel features of construction which are fully protected by broad patents. A pin is formed in the center of an annular hole milled in the rail by a hollow cutter. This pin fits into a hole drilled in the bond terminal and, being an integral part of the rail, makes current carrying contact on the inside of the terminal in addition to that secured on the outside as in the ordinary bond.



The Bond.

The bond is installed on the ball of the rail by driving the terminal home with a hammer. This operation compresses the copper and causes it to grip both the outer surface of the hole and the central pin. Mechanically, the bond is on to stay.

Electrically, the contact surfaces C, D and E are more than are required for the capacity of the bond. The contact surface C on the pin B is absolutely protected against moisture and other corrosive elements, being far removed from the outer surface of the rail.



The Annular Hole in Ball of Rail.

A special hollow milling cutter is provided for milling the annular hole in the rail. It is made of high speed steel and facilities are provided for quickly and accurately regrinding it in the field.

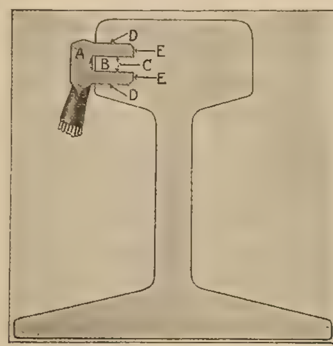
A motor driven milling machine has been developed for use in the installation of this bond. It mills two holes simultaneously, feeding the cutters automatically. When the holes are finished, the cutters are backed out, many times as fast as they were fed in, without stopping or reversing the motor.

The machine can be quickly clamped to the rail or released and is mounted on wheels for moving along the track. Two men can easily lift it from the track to allow cars to pass.

The motor is especially designed for this service and operates on a 550 volt d.c. circuit with a maximum current consumption of approximately 2 amperes. The controlling switch is located on top of the machine within easy reach of the operator.

Two men can mill the holes while a third cleans the holes, installs the bonds, removes crossing planks, etc

A prominent electric road recently installed many thousands of these bonds and report that under ordinary conditions three men can install from 125 to 150 bonds per ten-hour day.



The Bond Installed.

The Type J bond at present is made only in 4/0 capacity and is designed for use on 60 pound and heavier rails.

Like all other O-B bonds, the Type J is of all-wire construction, the terminals being formed of the same strands that compose the body.

ELECTRICALLY DRIVEN WOOD SAW.

An electrically driven wood saw is one of the latest devices to which Crocker-Wheeler motors have been applied. This wood saw which is the invention of Fred W. Walters, of Norfolk, Va., is said to cut a cord of wood, four pieces to the stick with one kilowatt hour of electricity which at the usual price is seven cents. This is cheaper than any other method now being used by from 25 to 50 per cent, and cheaper than firing a boiler with free fuel.

The motor driving this saw is a Crocker-Wheeler five horsepower induction motor used so extensively in plants where individual drive is essential. This motor is found to be of ample size for the heaviest kind of work and is equivalent to any ten horse power motor connected in the usual way, to shafting.

The motor is direct connected to the saw and insulated so well that there is no possibility of the operator receiving a shock. The portable stand is built of heavy steel angles thoroughly braced and riveted. There are no belts or pulleys to be renewed and the saw and motor runs at a continuous speed of 1800 r.p.m.

The equipment includes a fused starting switch mounted on the side of the motor so that the operator may start or stop the saw without leaving the machine.

RAPID TELEPHONE INSTALLATION.

The Kellogg Switchboard & Supply Company reports that an enterprising telephone company in Michigan recently lost their switchboard by fire. This was a special 200 line magneto board equipped to nearly half its capacity. A rush order was sent to the Kellogg Company for complete cable and rack equipment. Exactly forty-eight hours after the order was received this new equipment was on its way to the Michigan city, thus proving the reliability of Kellogg sales service in emergency requests for types of installations.

NEWS NOTES

INCORPORATIONS.

NEZPERCE, IDAHO.—The Grangeville Electric Company has filed articles of incorporation in this county, expecting to extend its lines to this city.

SANTA ANA, CAL.—Santa Ana Electric Company has filed articles of incorporation; directors being T. W. Neely, Annie H. Neely, J. G. Quick. The company's capital is $16,000.

SALEM, ORE.—The North Pacific Gas & Electric Company has been incorporated by C. J. Franklin, F. L. Shull, H. E. Lounsbury and W. W. Seymour and F. C. Brower; capitalized at $1,000,000. Main offices will be in Portland.

ILLUMINATION.

CHICO, CAL.—An expenditure of about $10,000 on a private power plant to provide electric light for Richardson Springs is being planned by the management of the resort.

LOS ANGELES, CAL.—Notice of voluntary application for dissolution of the Midway Light & Power Company was filed in the Superior Court January 27. Objections must be filed on or before February 28.

FOWLER, CAL.—The San Joaquin Light & Power Company has accepted the one-year contract submitted to them by the city of Fowler for the installation of a new lighting system, and will begin work at once.

REDWOOD CITY, CAL.—The recent election resulted in a decisive victory for the street lighting bonds. The bonds are for $6000, which will be expended by the city in extending the lighting system.

COLUSA, CAL.—The Board of Supervisiors of Colusa county has granted the Oro Electric Company a franchise for 50 years to build and maintain a power line on certain streets and highways of the county.

ALBANY, ORE.—Louis K. Kelsey of Portland is to have plans and estimates for a municipal electric lighting plant ready for submission to the council at the next meeting. The plant is to be capable of supplying current for 600 cluster light poles.

AUBURN, CAL.—The Pacific Gas & Electric Company has several surveying parties in the field surveying a line for a new ditch, from a point about Clipper Gap, to the territory lying between Ophir district and the western boundary of the county.

TRANSMISSION.

VICTORIA, B. C.—The Western Canada Power Company contemplates the installation of two new electrical units at Stave Falls.

TOLEDO, ORE.—Lewis Montgomery, Portland, has purchased the electric plant here. A power house will be built and new machinery installed.

SAN FRANCISCO, CAL.—The Nevada-California Power Company has declared a scrip dividend of $2 a share, payable February 10, to stock of record January 25th.

TACOMA, WASH.—Commissioner of Light and Water Nicholas Lawson, announces that wooden flumes at the Nisqually power plant will be re-placed with steel pipe. Work will be done by the city with pipe on hand.

REDWOOD CITY, CAL.—The franchise for the purpose of distributing electricity from Halfmoon Bay to the southern boundary of the county, has been sold to J. J. Gomes of the Halfmoon Bay Light & Power Company.

ANACORTES, WASH.—In a transaction involving a quarter of a million dollars, the Stone & Webster Corporation of Boston, has acquired the holdings of the Skagit Power Company near Rockport. Plans are said to include the developing of the power site into the biggest hydroelectric generating plant on the Pacific Coast, with power sufficient to electrify all the interurban lines of the company in western Washington. To put the plant in operation will require the expenditure of about six million dollars.

RENO, NEV.—Orders have been given by the Nevada Valley Power Company, which recently filed a $3,000,000 trust deed to secure bonds in that amount, for engineers to report in Reno within 30 days to start work on a power project a few miles from the Derby dam.

PALO ALTO, CAL.—John A. Britton of the Pacific Gas & Electric Company, has suggested a plan whereby the city can take over the local distributing lines and business of the company within the municipal limits. Britton broached his plan at a meeting of the corporation with the members of the Palo Alto board of public works. The meeting was held for the purpose of discussing a proposed ordinance requiring all wires carrying more than 5000 voltage to be carried underground. The matter was referred to Engineers Downing and Lisberger of the company and City Engineer Byxbee and City Electrician Youens.

TRANSPORTATION.

ORANGE, CAL.—The Pacific Electric Company has been granted the right to construct and maintain for 50 years, a railroad upon and across certain streets in this city.

SEATTLE, WASH.—The request of the Puget Sound Traction, Light & Power Company to construct a freight spur at Western avenue and Union street was granted by the board of public works.

PORTLAND, ORE.—Discontinuance of heavy traffic on the Sullivan gulch line and electrification of the road from the waterfront to Troutdale will probably be an early undertaking of the O.-W. R. & N. Company.

EUGENE, ORE.—Plans for the construction of a one story brick passenger depot to be erected here by the Oregon Electric Company will be ready for figures within the next two weeks. Doyle, Patterson & Beach, Worcester building, Portland, architects.

VICTORIA, B. C.—Twenty miles of the line of the Burrard Westminster, Boundary Railway & Navigation Company will be built this year between Stave River Falls and Pitt River. Work will be started in May. Eventually the line will be an electric one.

RENO, NEV.—Joseph Nenzel proposes to interest San Francisco capital in the construction of an electric tramway for the transportation of ore and supplies from Oreana to Rochester. The plans for an electric road from Oreana include the construction of a power plant.

EUGENE, ORE.—From an authentic source comes information that the Oregon Electric Railway will be extended from Eugene to Roseburg via Cottage Grove this season, and that from Roseburg the line will be built to Myrtle Point, to Coos Bay and thence south along the coast to San Francisco.

LOS ANGELES, CAL.—A sixty-day extension has been allowed the Los Angeles Railway Company by the board of public works, on improvement of Boyle street, from Stephenson avenue to Seventh street. Delay in city work has brought about the need of a longer time limit for the railway company's part of the work.

SAN BERNARDINO, CAL.—Bids for grading the Pacific Electric's proposed line to connect San Bernardino and Upland, forming a through service between Los Angeles and San Bernardino, will be opened February 20th, according to

the statement of President Shoup. The Pacific Electric will spend $1,500,000 for this line, exclusive of right-of-way.

SEATTLE, WASH.—The proposition of constructing a tunnel from Fourth avenue and Jefferson street, to Twelfth avenue and Jefferson, a distance of 2800 ft., with sufficient space for double car tracks, cluster lights, roadway and walks, will be taken up by the council if the recommendation of the streets and sewer commissioner is sustained.

LOS ANGELES, CAL.—Bids for the surrender of bonds issued by the Pacific Electric Company, dated March 12, 1902, under deed of trust to the Union Trust Company of San Francisco, will be received up to February 13th, the same to be indorsed "Bids for surrender of Pacific Electric Railway Company 5 per cent bonds, due January 1st, 1942."

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company has applied to Superintendent of Public Utilities A. L. Valentine for permission to double track its Meridian avenue line from N. Forty-sixth street and Meridian to N. Fifty-eighth street and Latona avenue, a distance of approximately one mile. Work will begin as soon as permission is granted.

EL PASO, TEXAS.—The contract for grading the interurban railroad from Washington Park to Ysleta, a distance of ten miles, has been let by the Rio Grande Valley Traction Company to Dudley & Kerr, contractors, with headquarters in El Paso. Work began February 1. Harry M. Potter, manager of the El Paso Electric Company, will be in charge of the Rio Grande Valley Traction Company's interurban line when completed.

OAKLAND, CAL.—At the annual meeting of the Oakland & Antioch Railway the incumbent officers were elected as follows: S. L. Naphtaly, president; W. Arnstein, vice-president; H. A. Mitchell, secretary and treasurer; John I. Walter, H. C. Breeden, A. W. Maltby and Burke Corbet. As the company is controlled through stock ownership by the Oakland, Antioch & Eastern, there will be no financial statement until the latter corporation has its annual meeting in April.

PORTLAND, ORE.—Electrification of the Mt. Hood Railway & Power Company's line, a subsidiary of the Portland Railway, Light & Power Company, will be started at once and within the next 30 days the trains of this road will be operated by electricity instead of steam over the first section of the system. This portion includes the nine-mile stretch from Montavilla to Gresham. The estimates for the work have already been approved and the work is to start just as rapidly as the labor, material and equipment for the overhead construction, bonding of rails, etc., can be assembled. The cost of electrification of the 23 miles of the road which now extends from Montavilla to Bull Run will cost roughly $160,000 to $175,000, and it is expected to have the entire road under electric motive power some time this summer.

TELEPHONE & TELEGRAPH.

MEDICINE HAT, B. C.—A contract has been awarded for the installation of an automatic telephone exchange for the city. The initial installation will be 2000 lines.

WINBERRY, ORE.—Winberry and Fall Creek residents are building a telephone line to Lowell, The two companies will use the same poles but separate lines will be strung.

BISBEE, ARIZ.—Louis Wolff of Guaymas has been granted concession for the installation of a telephone line between Guaymas and towns in Yaqui River Valley. The work is to begin immediately.

PLACENTIA, CAL.—Manager Lynch of the Pacific Telephone & Telegraph Company at a meeting of the Chamber of Commerce, assured that body that a telephone exchange would be established here within the next 60 days.

SAN FRANCISCO, CAL.—Investigation into the telephone rates has been begun by the board of supervisors, preliminary to the fixing of rates for the ensuing year. Representatives of the board conferred with the Railroad Commissioners and secured the services of Expert James T. Shaw to assist them in this work. The supervisors have begun the hearings which will extend over a period of some weeks.

WATERWORKS.

BERKELEY, CAL.—The first step toward the installing the high pressure water system in Berkeley was taken when the city council directed City Engineer J. J. Jessup to commence plans for a fresh water system.

LOS ANGELES, CAL.—The city of Los Angeles may take over the management of the Terminal Island water system from the city of Long Beach, July 1st. This proposal will be put into the hands of the city council of Long Beach at its next meeting.

VALLEJO, CAL.—Commissioner McCauley stated that he had tentative plans for the purchase of another watershed and the construction of still another large lake, and that a larger pipe line will soon have to be installed. This work will cost $250,000.

REDLAND, CAL.—The municipality of Redlands became the possessor of its own water system when the city paid over to the Domestic Water Company $225,000 for its line, wells and pumps. The city now proposes to improve and enlarge the system at a cost of $75,000.

PULLMAN, WASH.—The city council of Pullman has entered into a contract with B. T. Tannatt of Spokane to test the city wells and see if they have sufficient flow to furnish the city, and if they have, to have the sand removed and a new pumping system installed that will prevent the sand from being forced through the pumps into the pipes.

SAN FRANCISCO, CAL.—Spring Valley is ready to arbitrate the value of its plant or to facilitate the speedy determination of a condemnation suit. The company refuses the city's offer of $37,000,000 and half the impounded money, thus sustaining the stand taken by its negotiating committee. This was the formal answer transmitted to Mayor Rolph by the water company in reply to the formal offer made by the supervisors. On receipt of the letter, Mayor Rolph stated he would take the company's arbitration and condemnation proposition under consideration and submit the letter to the supervisors later.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Feb. 1.

The Railroad Commission rendered a decision granting the application of Moulton Irrigated Lands Company for authority to issue $250,000 of bonds.

A decision was rendered authorizing the Central California Gas Company to issue $12,500 of 6 per cent preferred stock to cover its organization and promotion expenses.

Feb. 3.

The Raymond Telephone Company applied for authority to raise rental service between Raymond and The Pines, via Coarse Gold and Fresno Flats, in Madera county, from $1 to $1.50 per month for residences; and from $1.50 to $2.00 per month for business telephones.

A decision was rendered granting a certificate of public convenience and necessity to the Los Angeles Gas & Electric Corporation to construct and operate a pipe line for conducting natural gas along certain highways in Los Angeles county.

Feb. 5.

A decision was rendered denying the application of the United Railroads of San Francisco to issue $2,350,000 of 6 per cent, five-year notes, and of the Market Street Railway Company to issue as collateral for these notes, $2,150,000 of its 5 per cent bonds. The commission sets forth at length its reasons for denying the application.

ALPHABETICAL INDEX TO ADVERTISERS

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

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General Electric Company

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Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Manhattan Elec. Supply Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
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Automobile Horns, Electric
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American Ever-Ready Co.
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Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
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Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
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Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

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Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

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Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

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Geo. E. Dow Pumping Engine Co.
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct," National Metal Molding Co.
"Buckeye," Elec. Agen. Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Cord, Flexible Bell
General Electric Company
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Pierson, Roeding & Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Pierson, Roeding & Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
"White," Elec. Agencies Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Dow Pump'g Engine Co., Geo. E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.

Economy Electric Co.
San Francisco, 444 Market

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 726 Mission
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

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Pacific Electric Mfg. Co.
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Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

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Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

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Manhattan Elec. Supply Co.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Sprague Electric Works

Hose, Armored
Sprague Electric Works

House Lighting Outfits
"Dayton," Elec. Agen. Co.

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
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Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor,"Pierson,Roeding&Co.
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"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
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"Pittsburg," Elec. Agen. Co.
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Blake Signal & Mfg. Co.
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Electric Agencies Co.
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
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Standard Und. Cable Co.
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Lamp Standards
Pacific States Electric Co.

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Fort Wayne Electric Works
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Western Electric Company
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Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Mazda, Gem, Tantalum and Carbon.
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Electric Appliance Co.
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Jos. Thieben & Co.
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"Star" Kendick Electric Co.
Western Electric Co.
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American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

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General Electric Company
Western Electric Company
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General Electric Company
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"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
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"M. & M." Elec. Agencies Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Switches, Snap
The Cutler-Hammer Mfg. Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Switches, Solenoid
The Cutler-Hammer Mfg. Co.

Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.

Switchboards, Power
Fort Wayne Electric Works
General Electric Company
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Western Pipe & Steel Co.

Tape.
General Electric Company
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Okonite Company, The
Pacific States Electric Co.
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Dean Electric Co.
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Tel. Protectors and Terminals.
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Water Supply Systems.
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General Electric Company
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Wire, Asbestos-Covered.
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Western Electric Company

Wire, Bare Copper.
General Electric Company
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Pierson, Roeding & Company
Standard Und. Cable Co.

Wire, Enameled.
General Electric Co.
Western Electric Company

Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
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Western Electric Company

Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.

Wire, Trolley.
Bridgeport Brass Company

Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
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Seattle, 1518 1st Ave. So.

Van Emon Elevator Co.
San Francisco, 56 Natoma.

Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company

Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758 W. Broadway

Westinghouse E. & M. Co.
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Seattle, Central Bldg.
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San Francisco, 165 Second
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Portland, Couch Bldg.
Butte, Lewisohn Bldg.

Westinghouse Machine Co.
San Francisco, 141 Second

Westinghouse-Church-Kerr Co.
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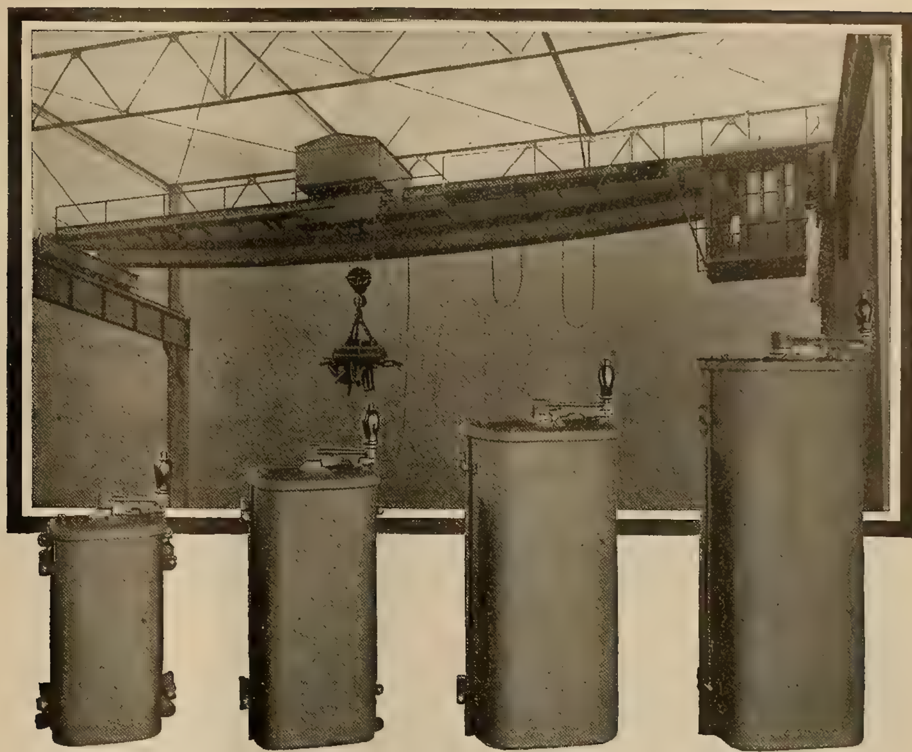
Los Angeles, Cal., Pacific Electric Bldg.

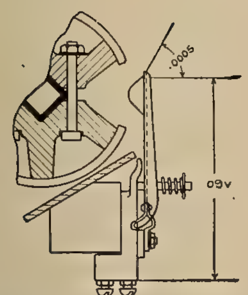
Weston Elec. Instrument Co.
San Francisco, 682-684 Mission

Wilson Machinery Co.
San Francisco, 361 Market

PROFESSIONAL DIRECTORY



CUTLER-HAMMER
Drum Type Controllers
Have Been in Service Nearly Two Years



Details of Cutler-Hammer Drum Controller Contacts. Reproduced From Diagram Which Appeared in Cutler-Hammer Drum Controller Bulletin, Almost Two Years Ago.

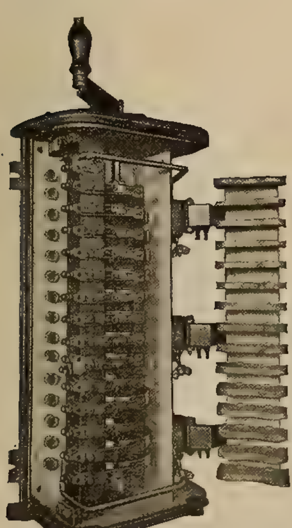
Cutler-Hammer enclosed drum type controllers for crane and hoist service are not new,—they have been in successful service for nearly two years. The success of these controllers has made the enclosed type controller popular.

It is possible to imitate some features of these controllers, but there is no copying of Cutler-Hammer experience and specialized engineering service.

Cutler-Hammer engineers have developed all features of the enclosed drum controllers, step by step;—the straight non-stubbing fingers are so designed as to insure smooth uniform contact with the contact segments; the rotary motion is easy and smooth; powerful magnetic fields obtain a blowout on every finger and segment; and the tight fitting drum prevents accidents.

We know the reason for each feature and detail of these controllers because we developed them and the two years in which they have been in service have proven them right.

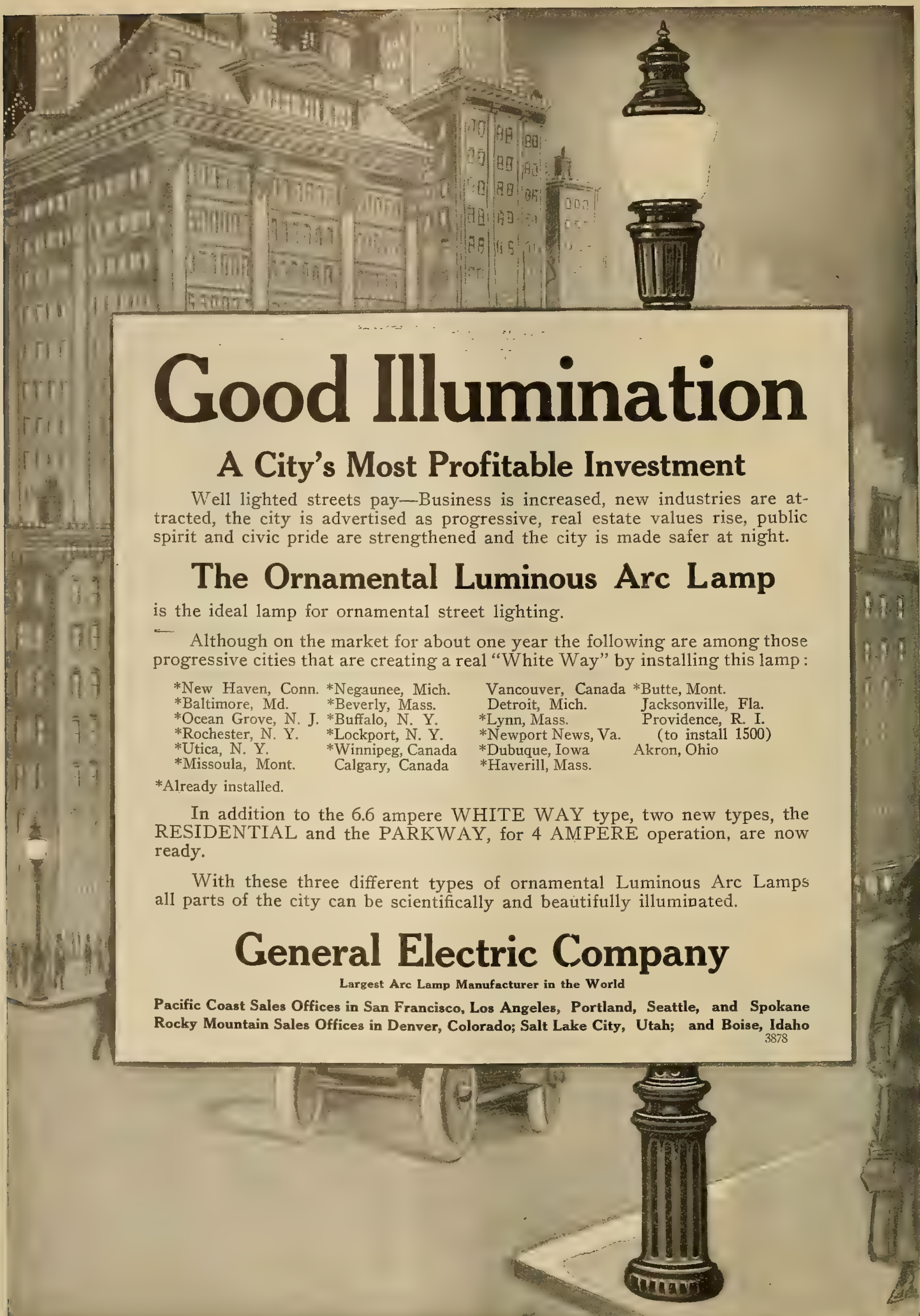
Cutler-Hammer drum controllers have the original non-stubbing finger. Bulletins 5300, 5310, 5330, 5340, 5350 and 5360 describe direct current types; Bulletins 9350, 9360 and 9365, alternating current types. Shall we send these to you? Just let us have your address.



Interior of Controller, Showing the Original Straight Non-stubbing Fingers.

The Cutler-Hammer Mfg. Co.
Milwaukee, Wisconsin

NEW YORK: Hudson Terminal, 50 Church St. CHICAGO: Peoples' Gas Building.
PITTSBURG: Farmers' Bank Building. BOSTON: Columbia Life Building.
PHILADELPHIA: 1201 Chestnut St. CLEVELAND: Schofield Building.
PACIFIC COAST AGENTS: H. B. Squires Co., 579 Howard St., SAN FRANCISCO; 229 Sherlock Bldg., PORTLAND, ORE.; W. B. Palmer, 416 E. 3rd St. LOS ANGELES.


Good Illumination
A City's Most Profitable Investment
Well lighted streets pay—Business is increased, new industries are attracted, the city is advertised as progressive, real estate values rise, public spirit and civic pride are strengthened and the city is made safer at night.
The Ornamental Luminous Arc Lamp
is the ideal lamp for ornamental street lighting.
Although on the market for about one year the following are among those progressive cities that are creating a real "White Way" by installing this lamp:
*New Haven, Conn.
*Baltimore, Md.
*Ocean Grove, N. J.
*Rochester, N. Y.
*Utica, N. Y.
*Missoula, Mont.
*Negaunee, Mich.
*Beverly, Mass.
*Buffalo, N. Y.
*Lockport, N. Y.
*Winnipeg, Canada
Calgary, Canada
Vancouver, Canada
Detroit, Mich.
*Lynn, Mass.
*Newport News, Va.
*Dubuque, Iowa
*Haverill, Mass.
*Butte, Mont.
Jacksonville, Fla.
Providence, R. I. (to install 1500)
Akron, Ohio
*Already installed.
In addition to the 6.6 ampere WHITE WAY type, two new types, the RESIDENTIAL and the PARKWAY, for 4 AMPERE operation, are now ready.
With these three different types of ornamental Luminous Arc Lamps all parts of the city can be scientifically and beautifully illuminated.
General Electric Company
Largest Arc Lamp Manufacturer in the World
Pacific Coast Sales Offices in San Francisco, Los Angeles, Portland, Seattle, and Spokane
Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho
3878

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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HYDROELECTRIC DEVELOPMENT ON KLAMATH RIVER.
BY J. C. BOYLE.

TRANSFORMER CONNECTIONS.
BY W. A. HILLEBRAND AND E. R. SHEPARD.

ELECTRIC PUMPING AND IRRIGATION.
BY B. A. ETCHEVERRY.

STEAM TURBINES AND BOILERS.
BY C. H. DELANEY.

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JOURNAL OF ELECTRICITY
POWER AND GAS
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HYDROELECTRIC DEVELOPMENT ON KLAMATH RIVER

BY J. C. BOYLE.

View of Gorge and Proposed Dam in Outline.

The hydroelectric development now under construction for the California-Oregon Power Company, is situated on the Klamath River thirteen miles east of the Southern Pacific Railroad station at Thrall, Cal. It is near the geographical center of a territory of 10,000 square miles in Southern Oregon and Northern California over which the company is now distributing 20,000 horsepower and in which it will eventually develop 150,000 horsepower. The nearness of the installation to the central distributing station of the company makes it a valuable economical power acquisition.

The engineering structures, dam, power house and forebay, with all the smaller structures are combined under the name of Klamath River Dam No. 1. They are located together practically as a unit at the head of a canyon which has been formed by the Klamath River, eroding five distinct lava flows. Although the country surrounding the construction site is principally lava, and the walls of the canyon

themselves vary to 250 ft. in height in lava, the river in its erosion has exposed a reef across the canyon at the location of the dam, approximately 130 ft. high. This reef is of andesite, apparently continuous for considerable distance on both sides of the canyon and considered the oldest exposed formation in the country.

Geographical conditions upstream from the site indicate that at one time the river ran over this reef, 130 ft. above its present bed. During the time that the river was at this height the water was backed up approximately 5 miles and formed a natural lake which varied in width to a mile at the widest part.

It is now proposed to fill the gorge made by the river in eroding the reef, with a concrete dam, and cover the old original lake bottom with a new artificial lake. The new lake will have a surface area

Map of Territory Served by California-Oregon Power Company.

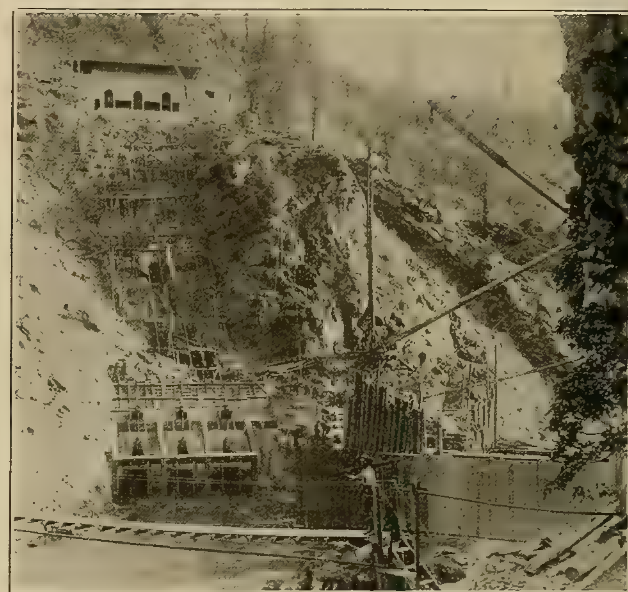
of 1000 acres and will have a catchment of 77,000 acre ft. This will be the third lake on the course of the Klamath River between its source and the construction site. Two large Klamath Lakes at present regulate the flow of the river at its source so that the high water mark at the construction site is never over 6 ft. above the low water mark, and the new lake with its regulation will control the floods of the river to a still greater degree. From gaugings taken for one and one-half years near the site, the maximum discharge of the river has been 4500 cu. ft. per second, and the minimum discharge has been 1450 cu. ft. per second. Taking the average for the same period as 2000 cu. ft. per second and allowing it to flow into the lake, it will take 20 days for the lake to fill. For utilizing a portion of this body of water allowance is being made for lowering the lake level 2 ft., thus supplying 2000 acre ft, of storage water to be used with the flow of the river for power during the low water season or to be used whenever a demand is made for it.

Construction Features.

Two of the most interesting construction features of this installation are, the diversion of the river from its channel while the foundations are being placed for the dam, and the procuring and delivering of material for the installation.

Diversion.

The width of the canyon at the base of the dam is 70 ft., all of which is taken up by the water of the river. For 150 ft. above the dam and for 350 ft. below the dam, the river channel has a grade of 2 ft. per hundred, producing a velocity in the water of about 20 ft. per second. The erosion produced by such a current would not permit winging the river from side to side, neither would blasting in the river bottom permit fluming the river, so a wing dam of



Side Hill Construction Already Accomplished.

rock-filled cribs, 30 ft. high was made 100 ft. upstream from the main dam.

This wing dam diverts the river from its original channel through an unlined tunnel around the east end of the dam. This tunnel is 356 ft. long with a cross section of 16 ft. by 18 ft. and a grade of 2 ft. per hundred.

On entering the tunnel the water passes through three sets of headgates, designed for 110 ft. pressure head and designed large enough to carry the average flow of the river under a head of 10 ft. Each set of gates consists of a clack valve covering the entrance to a 6 ft. depth by 30 ft. pipe, with a butterfly valve 6 ft. in diameter in the middle of the pipe and a 12 in. by-pass valve to the chamber between the large valves for equalizing the pressure behind the clack valve. Each valve is operated directly and independently by a specially designed operating wheel on an operating platform above the crest of the dam. The three pipes containing the three sets of valves are placed side by side horizontally in the direction

of the tunnel and securely concreted together, thus forming a solid block to the entrance of the tunnel.

Delivery System.

In the delivering of materials, supplies and equipment to the site, a valuable acquisition has been made of a standard gauge branch railroad which extends up the Klamath River from Thrall. By building a spur track less than a mile in length to connect with this railroad, all the freight can be delivered directly from Thrall (13 miles) to the edge of the bluff overlooking the dam site. The construction camp, warehouses, machine shop, cement house, etc., are all located at the end of this railroad spur.

The top of the bluff overlooking the dam site is 100 ft. in elevation higher than the crest of the dam. The first 50 ft. of this elevation is taken up by a mixing plant, consisting of two sand machines, two rock breakers, and two mixers, all electrically operated. The output of this plant will be 720 cu. yds. of concrete per day of 9 hours.

Back from the edge of the bluff 400 ft. is a cinder cone of a consistent quality of black volcanic cinder, which, after analyses and extensive tests was found to be useful as a substitute for sand in the concrete. A gravity tramway to the edge of the bluff at the mixing plant, will handle the cinder directly to the two sand machines, which together will crush it to the required size and deposit it in a storage bin below.

The two rock breakers in the mixing plant will crush rock handled directly to them by the derrick from the quarry, and discharge the broken pieces into a storage bin beneath them.

All the cement used will be handled from the cars to the storage house or directly from the cars to the mixing plant and after passing a small storage bin will be measured into the charging hoppers of the mixers.

The ingredients thus passing into the mixers by gravity are mixed at the rate of 40 cu. ft. per batch into concrete. The concrete is discharged from the spouts of the mixers into open troughs in which it travels by gravity across the canyon or to any spot where it is to be placed. Remixers, boiling boxes and branch troughs can be placed where needed.

For delivering the rock to be laid with the concrete, a rock cableway with a traveling carrier has been provided. The rock will be quarried from a lava bluff down stream from the forebay but above it in elevation. That which goes into the dam as laid stone will be taken by gravity to the forebay level to be handled with the carrier to any place in the dam and the small rock quarried at the same time will be taken by the derrick directly from the quarry to the rock breakers above.

The economical value of such a gravity system can best be underestimated when the fact is considered that by means of it, all the concrete for the forebay, all the concrete for the power house and three-quarters of the concrete in the main dam can be placed, some 55,000 yds. in all, without elevating a yard of it.

The head gates, wing dam, mixing plant and smaller engineering structures have been completed, and in all probabilities concreting on the larger structures, dam, power house and forebay, will be started in the early summer of 1913. Upon completion of this installation the California-Oregon Power Company will have added to its power developments a hydroelectric plant capable of producing 53,000 horsepower. This along with the available storage for peak loads, within one and one-half miles of the central switching station at Fall Creek, will make it one of the controlling plants of the company's extensive distributing system.

The Dam.

The dam to be built will be of the arch-gravity type, 130 ft. in height above the bed of the river, 90 ft. thick at the base and 13 ft. thick at the top. The length of the crest will be 400 ft., curved on the arc of a circle of 356 ft. radius, curvature upstream. The center 200 ft. of the crest will be an overflow section capable of discharging the highest flood waters. At the upper toe there will be a cutoff wall 10 ft. thick extending below the foundation of the dam at least 10 ft., and at the lower toe there will be provided an apron which will discharge the overflow water in a horizontal position.

Owing to the position of the canyon walls at the dam site, it was found impossible to place the structure perpendicular to the river bed, the west abutment being further down stream than the east abutment. However, by making the dam curved with a 356 ft. radius the ends were found to strike the canyon walls nearly perpendicularly.

The total yardage of the dam will be about 35,000, of which between 40 and 50 per cent will be laid stone. To reinforce the dam on the bottom and on the upstream side, and to facilitate in handling forms, 30 lb. railroad rails will be imbedded in the concrete. These will be spaced 4 ft. centers, 4 ft. from the face of the concrete and laced together horizontally both across the dam and through the dam.

The Power House.

The power house will be of reinforced concrete with floor dimensions 70 ft. by 170 ft. and will eventually contain four complete hydroelectric units with exciters, switchboards and transformers.

Each unit will be made up of a 12,500 k.v.a., 10,000 kw. at 80 per cent power factor, 200 r.p.m., 2300 volts, generator, weighing 325,470 lb., connected with an 18,600 h.p. cylindrical type hydraulic turbine of 84 per cent efficiency, 20 per cent speed rise, 200 r.p.m., weighing 400,000 lb. and governed by an a.c. oil pressure type, fly ball governor of 75,000 ft. pounds capacity.

The penstocks for each unit will be a pipe 125 ft. long, 17 ft. in diameter, and on a hill slope of 37° 30′ from the power house. The penstock will be made of sheet steel ½ in. thick at the upper end and ¾ in. thick where it enters the turbine. The water carried in it will have a velocity of about 5 ft. per second, depending on the load on the turbine.

The discharge from the turbine will be through a draught tube of special curved design located beneath the turbine and the generator floor. It will be made of concrete heavily reinforced on the top with I-beams. The area of the draught tube increases from 103.8 sq. ft. at the bottom of the turbine to 535 sq. ft. where the water leaves the power house.

The exciter units will consist of two trubine driven exciters and one motor generator exciter. The turbine driven exciters will be 200 kw., 720 r.p.m., 250 volts, and the turbine will be 300 h.p., 720 r.p.m., 83 per cent efficiency and connected with an oil pressure type, fly ball governor of 10,000 ft. pounds capacity. These units will be so connected that any one can be used on any four main generators.

For each unit in the power house there will be 3 single-phase transformers each of 4165 k.v.a., 2300 volts. The current from the generators will be run through a gallery switchboard to these transformers, thence out on a short line of one and one-half miles to the central switching and transforming station at Fall Creek.

The Forebay.

The forebay will be the supply reservoir for the penstocks for the power house. It is located at the west end of and adjoining the main dam and extends 200 ft. around the canyon to a position directly above the power house. Excavation has been made to a depth of 25 ft. below the ultimate crest of the dam, allowing 6000 cu. ft. per second to enter to the penstocks at a velocity of 5 ft. per second. An auxiliary spillway has been provided on the side of the forebay adjoining the dam, for relief when the water in the forebay rises above normal, and for taking care of any surge in the penstocks. A set of three gates will be provided for each penstock. These gates will be operated independently in sets so that any unit can be closed down without effecting the others. Racks and screens will be provided independent of the gates of sufficient size to allow the passage of the water and to take out all floating material.

The outer wall of the forebay, where the penstocks enter will be 10 ft. thick, 30 ft. high and anchored at the bottom. The inner wall will be a reservoir wall of 6 in. thickness with a batter of 1 in 10 and made continuous with the floor system. Both inner wall and floor system will be reinforced as a floor slab. Ample floor drains and side drains will be provided to take care of any seepage through the concrete.

The work is under the supervision of Mr. Sidney Sprout, superintending engineer of the California-Oregon Power Company, and Mr. A. C. Sprout, construction engineer of the California-Oregon Power Company, J. C. Boyle being engineer in charge.

TRAVELING AN ELECTRIC-HAULAGE ROAD.

In a discussion of accidents from mine cars and locomotives, the Bureau of Mines in its circular No. 11, thus describes dangers in traveling on an electric-haulage road:

The road you have to take in going to your working place is likely to be an electric-haulage road, because in the level mines of the United States, except in some gaseous mines, electric haulage is being used much more than any other mechanical means of hauling cars.

If you are carrying tools, such as a pick, a bar, or a drill, do not carry them over your shoulder. Many fatal accidents have happened because tools so carried struck the trolley wire. Even if the power is off the wire when you pass, get in the habit of not touching it.

TRANSFORMER CONNECTIONS.

BY W. A. HILLEBRAND AND E. R. SHEPARD.

(Concluded.)

Three transformers may be used with excellent results, on balanced or unbalanced loads, but only when the transformers used as the top of the T, a b of Fig. 15, are in multiple on the two-phase side. The

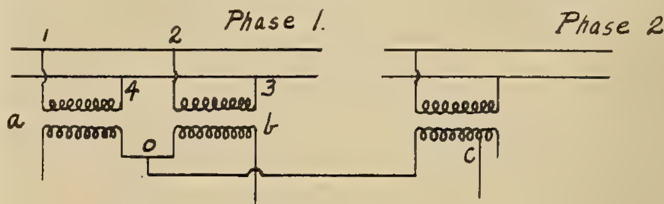


Fig. 15.

current in o c, which must divide at o and flow oppositely to a and b, induces in the circuit 1-2-3-4 a circulating current which prevents any choking effect.

An attempt to operate with coils 1-4 and 2-3 in series, as in Fig. 16, will lead to extreme unbalancing,

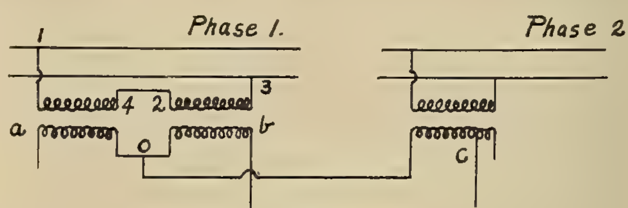


Fig. 16.

for currents cannot now flow in the circuit 1-4-2-3 to neutralize the choking effect of the currents flowing oppositely from o to a and to b.

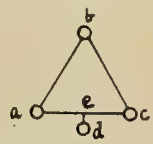


Fig. 17

In Fig. 17 is shown a system for furnishing both two and three-phase service at a common voltage, using for the most part the same transformers and but four wires. The three-phase system is a, b, c; the two-phase ac and bd.

To obtain the two-phase system from the three-phase, all that is necessary is to add the voltage d e, equal to 13.4 per cent of the delta voltage a b, and of the phase position be. Practically this may be accomplished by any of the connections shown in Figs. 18 to 21 inclusive.

In the connection of Fig. 18, b d is an auto transformer or primary of a standard transformer, connected at e, an 86.6 per cent tap. Instead, a transformer may be employed having the ratios 2200:440:

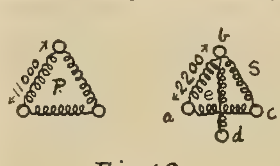


Fig. 18

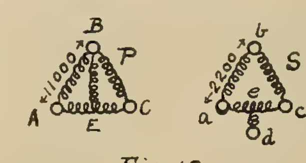


Fig. 19

220:110, in which case the full primary is used across b e and three-fourths of the secondary as e d. The rating of b d need only be 13.4 per cent of that of

either of the others.

Fig. 19 requires for b e the full primary of an 11,000 volt transformer, and the secondary e d, three-fourths of a nominal 440 volt winding. The capacity of this transformer is also but 13.4 per cent of that of either of the others.

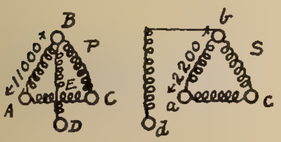


Fig. 20

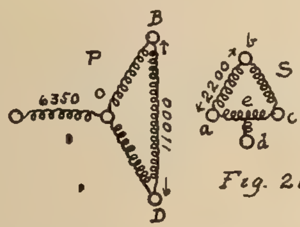


Fig. 21

B D of Fig. 20 is an 11,000:2200 volt transformer of the same capacity as each of the others.

In Fig. 21 B D has an odd ratio of 11,000:395 or 37.3:1, whence it is not to be considered as a practical case.

Technically, the behavior of all of these cases is similar so that only the connection of Fig. 18, reproduced in Fig. 22, will be considered in analyzing the flow of currents in the transformers.

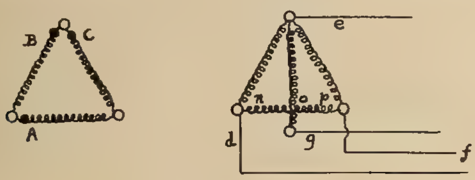


Fig 22

Single-phase current drawn by e g is supplied by transformers e d and e f and flows in opposite directions through n o and p o. With non-inductive load this current is 30 degrees out of phase with e d and e f and 90 degrees out of phase with n o and p o. The vector diagrams are shown in Fig. 23 to 25 inclusive.

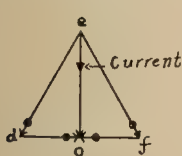


Fig. 23

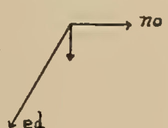


Fig. 24

Fig. 25

Single-phase current drawn by d f is principally furnished by transformer n o p but also in part by the parallel circuit d e f. On non-inductive load the current furnished by transformer n o p is in phase with voltage d f, whereas that furnished by circuit d e f is 60 degrees out of phase with e.m.f.'s d e and e f. The The vector diagram is given in Fig. 26 and 27.

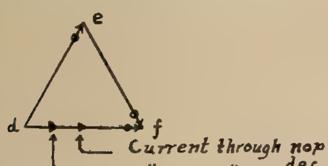


Fig. 26.

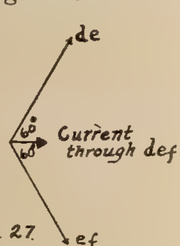


Fig. 27

Any three-phase current supplied to a balanced load, flows equally in each of the delta connected transformers at the power factor of the load.

The two-phase load draws currents, some of which flow through the transformers at power factors other than that of the load. When these currents of various power factor combine with currents drawn by a three-phase load, the resultants in the different transformers or in the two secondary coils of transformer n o p will not be alike.

As an illustrative case, the vector diagrams for a balanced two-phase load of 12 amperes per terminal at unity power factor and a balanced three-phase load of 12 amperes per terminal at 86.6 per cent power factor lagging, are shown in Figs. 28 to 31 inclusive, for the four circuits d e, e f, n o, o p, of Fig. 22. The further assumption is made that of the 12 amperes two-phase load drawn by d f, 8 amperes flow through n o p and 4 amperes via d e f.

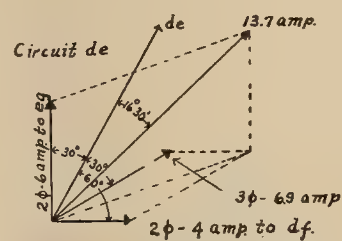


Fig. 28.

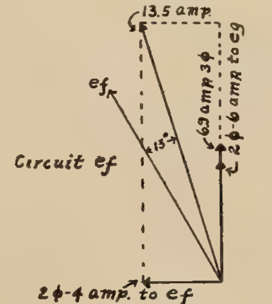


Fig. 29

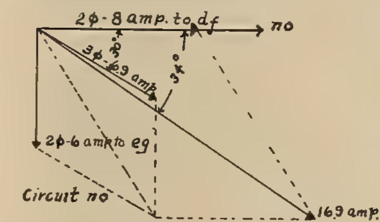


Fig. 30

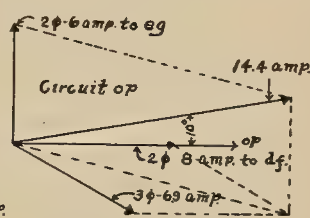


Fig. 31.

These diagrams represent currents in the secondaries, neglecting magnetizing and load current in current o e, the primary of the auto transformer. The primary current in transformer n o p is half the vector sum of currents in n o and o p, reducing to basis 1:1 transformation.

In an actual case the current distribution is altered by the fact that due to the different currents and power factors, the various sections will regulate differently, causing the ultimate distribution to depart from the simple law of Figs. 28 to 31, in a way that may be difficult to calculate. However, the following record of an actual test may serve to indicate what might be expected. Where two and three-phase loads were both applied, each was of the same value as when applied singly. The letter designations refer to Fig. 22 and primary currents are expressed in secondary terms.

Transformers e f, f d and e g are 7½ kw. 2200-220-110 volt, shell type, of the same make and period. Transformer e d is a 4 kw. core type transformer of same voltage rating but of an earlier period and different manufacture.

It would appear that with balanced two and three phase load, that transformer which is n o p of Fig. 22 carries somewhat the greater current. Any unbal-

ancing of the two-phase load tends to overload this same transformer which carries the currents of both phases. When the power factors of the two and three-phase loads are equal, the total currents in each half of the secondary of n o p are equal.

If

I_3 = amperes per terminal 3-phase.
I_2 = amperes per terminal 2-phase.

an approximation to the maximum possible secondary current in either half of this transformer is

$$I = .57\, I_3 + .84\, I_2.$$

Two-phase and three-phase service may also be furnished over four wires by means of the connection shown in Fig. 32, which requires however the use

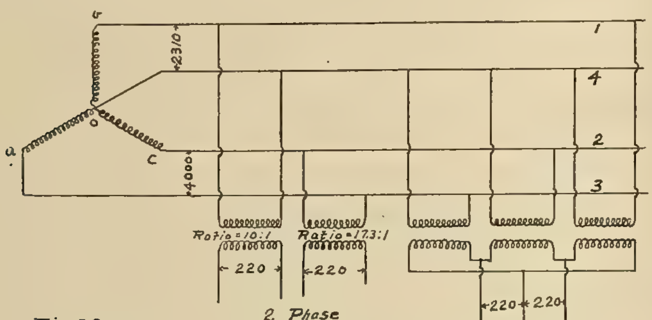


Fig. 32

of a transformer with an odd ratio, 17.3:1, for each two-phase motor installation. Half of the two-phase power is furnished by transformer o b and half by the other two transformers, so that, in the proportion of the two-phase load to the total, o b should be 1.73 times as great as each of the other two. The excess volt-ampere capacity of a o and o c is due to the fact that the single phase current is furnished by o a and o c at a reduced power factor, 86.6 per cent when the load is non-inductive.

An unusual scheme for deriving a two-phase supply from a three-phase source, using three transformers, is illustrated in Fig. 33, in which o e is a separate

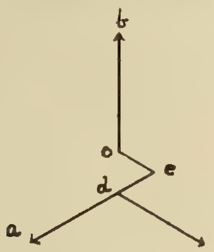


Fig. 33

coil wound on the same core as d c. The two-phase voltages are b d and a c. Three-phase cannot be supplied. Referred to o b, voltages o e and e d may be derived as follows:

$$^{*}\; bd = ob + od = ac. \qquad (1.)$$

Calling $oe = ed = x$.

Then $ob + 2x \sin 30° = 2\,(ob - x) \cos 30°$.

$$x = .267\ ob.$$

From equation 1, $ob + .267\,(ob) = ac$.

$$ac = 1.267\ ob.$$

That is, the new two-phase voltage is 26.7 per cent greater than the three-phase neutral or 73 per cent of the original three-phase delta electromotive force.

The primaries of the system must be connected in delta. The three transformers are of the same volt ampere rating but this connection reduces the power output when fully loaded to 84.4 per cent of the aggregate capacity as single-phase apparatus.

No	CURRENTS									VOLTAGES				LOAD
	A	B	C	d	e	f	g	n	p	de	ef	fg	eg	
1					15					light = loaded		= 119 = 116		Single-phase, non-inductive on eg. Transformer ed open circuited.
2					15.1					light = loaded		= 119 = 117		Same as Nº 1. Transformer ef open circuited.
3	3	11.6	8.0	.	15.3			11.5	7.3	120.5	121.5	120.5	118.0	Same as Nº 1. All transformers in service
4	10.6	13.6	9.0	15.4	15.4	15.4	15.4	14.9	12.8	123.0	122.5	122.4	120.0	Balanced, non-inductive 2 phase.
5	9.8	12.0	10.0	15.5	15.0	16.5	0	9.0	9.1	121	120	120	119	3 phase induction motor.
6	19	23.2	18	31	31	29	15.2	22.8	18.9	119	120	118	118	Combined loads of 4+5.
7	11.	12.8	9.8	15	14.2	15	14.2	14.4	13.1	119	118	119	116	2-phase induction motor.
8	19.2	21.6	18	29.5	29	31	15.0	21.6	21.6	118	117	116	116	Two and three Φ motors of 5 and 7

Relationship of Currents, Voltages and Loads in Varying Circuits.

In conclusion, the authors wish it understood that they have not attempted to analyze all known or possible combinations for two and three-phase transformation, but only typical cases, with the purpose of presenting a general method for the determination of current distribution in interconnected transformers.

PULLING ELECTRIC CABLE IN PANAMA CANAL LOCKS.

Electric cables for the control, power, and lighting systems of the locks will be carried in vitrified clay duct, which has already been placed at Gatun and Pedro Miguel Locks and is being placed at Miraflores. For the control and power systems 246 miles of lead covered cable are to be pulled through these ducts, 40 per cent of the total amount that was placed by the largest power company in the United States during the twenty years preceding 1908. In addition there are 112 miles of wire of miscellaneous sizes from No. 12 up to 00 B. & S. gage for the lighting system.

This work in the locks was begun in October and will be finished in June. On account of the large amount of cable to be handled the expedient of laying it from an electrically driven winch has been resorted to. Before the operation is begun the ducts are carefully cleaned. Then a lead wire is pulled through, and by this means a manila cable is drawn through the duct. The electric cable is attached to the rope, and the winch is set in motion. By this method it is possible to pull 900 ft. lengths of No. 0000 B. & S. gage lead covered cable at one time, whereas the average length by other methods is about 300 ft. The outside diameter of this cable is a trifle more than 2 in. In such a length the cable passes through two intermediate manholes, and is greased at three points to aid in reducing friction. The advantage of pulling the long sections at one operation is that the making of two joints is saved, and this is a considerable economy. The winch used for the purpose is mounted upon trucks operated over the return tracks of the towing system. The cable is being placed directly below the floor of the operating tunnel, and therefore the pull by the winch is direct.

ELECTRICAL PUMPING AND IRRIGATION

DESIGN OF REGULATOR AT HEAD OF MAIN CANAL

BY. B. A. ETCHEVERRY.

The factors entering in the design of regulators are:

1st. Position of regulator relative to weir.

2d. Relative elevation of sill of headgates and crest of weir.

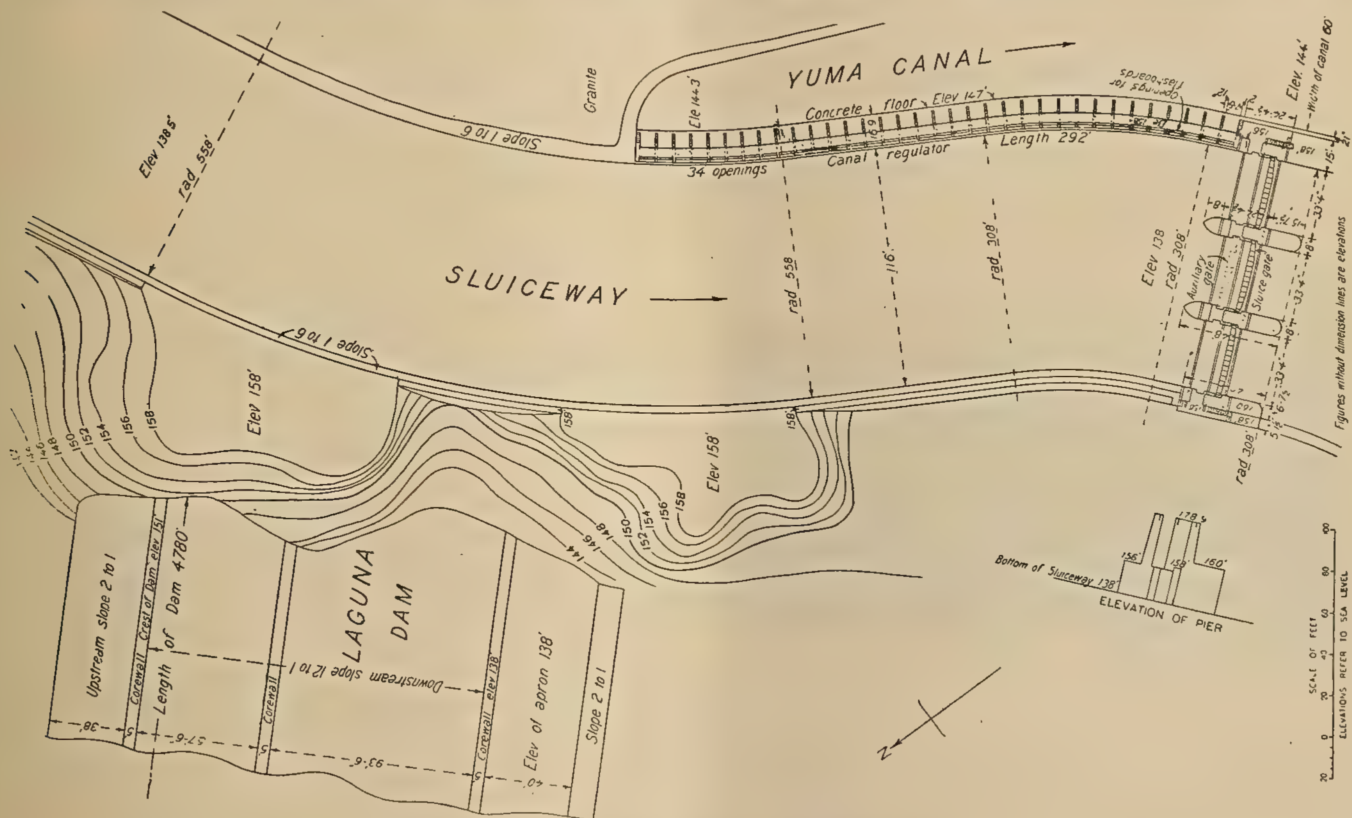
3d. Height and width of gate openings.

4th. Elevation of top of headgates and operating floor.

5th. Details and design of headgates.

1st. Position of regulator.

The most desirable position for the regulator is at one end of the weir, directly above it and at right angles to the axis of the weir. The adjacent scouring sluices keep a clear channel in front of the headgates. The general plan of the diversion dam and headworks for the North Platte project shows the arrangement of the different parts of the diversion works on a typical irrigation system. Where the river carries considerable sand or silt the regulator may be formed by placing at the head of the canal an overflow wall, at right angles to the weir, parallel and adjacent to the sluiceway, and locating the headgates proper lower down, either on the same axis as the weir, or at some distance below. The overfall wall and the headgates with the channel in between form a basin; the water passes over the wall into the basin, and the flow into the canal is regulated by the headgates. The object of the overflow wall is to skim only the surface water, and to accomplish this it is necessary to use a length of crest which will give the required volume of water in the canal, for the desired depth of water on the crest. This depth of water will usually represent the required difference in elevation between the weir crest and the crest of the wall. This form of construction is illustrated by the diversion works on the Shoshone River for the Corbett tunnel (see preceding article in Journal of Electricity, Power and Gas, Feb. 15, 1913). The same result may be obtained by regulating the flow over the overfall wall by means of gates placed above and at the crest of the wall. This will obviate the necessity for the headgates below, and the only difference between this form and the one first mentioned is that a larger total width of gateway must be used. This will increase the cost of gates which, however, will be at least partly offset by the omission of the separate overfall wall and basin. This form of construction is well illustrated by the headworks of the Yuma project. The headworks consist of a diversion weir of the Indian type with a large sluiceway and canal headgate on each end of the weir, one on the California side and the other on the Arizona side. The sluiceway and regulator at the head of the canal on the Arizona side is shown in the accompanying plan. The sluiceway, which is 116 feet wide, runs around the end of the weir. The flow through this sluiceway is controlled by three large gates. The uphill bank of the sluiceway for a length of 292 ft. upstream from the sluicegates is the canal regulator. It consists of an overflow wall divided into 34 openings by piers between which flashboards can be in-



Canal Regulator, Laguna Dam, California-Arizona.

serted to raise or lower the crest of the wall so as to skim the surface of the water and regulate the flow into the canal. A similar arrangement of sluiceway and regulator is shown by the diversion works of the Salt River Project at the site of the Granite Reef Dam.

2d. Relative elevation of sill of headgates and crest of weir.

The diversion dam must always be built high enough to insure a full depth of water in the canal. This requires that the crest of the weir or the minimum low water level over the weir be made slightly higher than the full supply level of water in the canal, depending on the velocity desired through the gate openings. The desired velocity need not exceed the velocity in the canal. It is preferable to use a greater area of gate openings and a lower height of weir. Usually less than 6 in. difference in elevation between the full supply level in the canal and the crest of the weir or the low water level over the weir is sufficient. On most streams the depth of overflow during the period of low stream flow is small and often nothing.

A common case in practice is where the diversion weir must be built at a selected weir site to raise the water to a desired water level in the canal at the

Headworks North Platte Project, Nebraska-Wyoming. Project, Washington.

headgate. This condition determines the elevation of the weir crest. Other cases which occur in practice are those where the weir site is selected but where the available fall in the diversion line permits considerable range in the selection of the water level in the canal. For these conditions it is necessary to find the combination which will give the most economic total cost of diversion weir, headgates and canal. A low water level in the canal will decrease the height of weir, but may increase the depth of cut of the diversion canal; this is usually the case where the bank of the river on which the canal has to be constructed is a flat bench.

3d. Height and width of gate openings.

The total cross section of gate openings is determined by the velocity of flow through the gates. This, as previously stated, need not be greater than the velocity in the canals. A low velocity increases the total area of gate opening but decreases the required weir height. A large height of gate opening decreases the required total width of gates, but may require a higher weir. The maximum height of openings will not exceed the depth of water in the canal and usually will be less. A smaller height requires that the gate sill be raised above the floor of the canal. This decreases the required weir height and also the intensity of pressure on the gates and it has the advantage that the top water of the stream is taken in the canal; this is desirable for streams carrying much sand or silt. The total width of gateway is usually divided by piers, buttresses or columns into a number of openings, whose maximum width depends somewhat on the pressure and type of gate, but is rarely greater than 8 ft. and is usually from 4 to 6 ft.

4th. Elevation of top of headgate and operating platform.

The top of the headgate and operating platform must be at least as high as the maximum high water level to prevent overtopping.

5th. Details and design of headgates.

The headgate structure consists of:

(a) An overflow wall and basin above the headgate, used in some cases when the water carries much silt and it is desired to skim the top of the water.

(b) Substructure consisting of a floor, aprons, or cut off walls and a gate sill.

(c) Wing walls and side walls.

(d) Buttresses, columns or frames with grooves into which the gates are set.

(e) Panel wall to close the openings between the buttresses above the gate openings.

(f) Gates.

(g) Operating platform.

(h) Gate lifting device.

THE K.V.A. RATING OF A GENERATOR.

In a three-phase alternating current circuit, the power is computed by the well-known formula

$$P = \frac{\sqrt{3}}{1000} EI \cos \theta$$

where

P = power in kilowatts.

E = voltage between wires.

I = current in amperes passing through one wire.

θ = the phase displacement between current and electromotive force.

$\cos \theta$ = power factor.

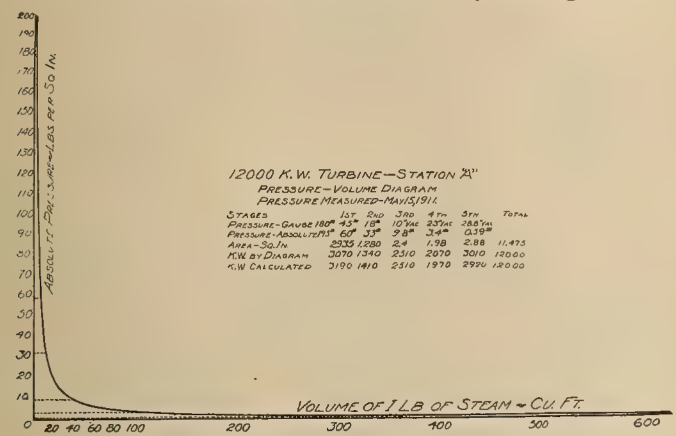
Since the characteristics of the external circuit thus impose a burden upon a generator to produce more voltage and more current when a highly inductive circuit is fed, the product of volts and amperes will thus be materially greater. Since the limit of the generating capacity of an alternator is dependent upon its ability to dissipate heat and since this generating for heat is caused both by strength of voltage and current attained in the generator windings, the output on kilowatt basis is thus lessened by the characteristics of the distributing network. Hence the only fair basis of rating a generator is on the kilovolt ampere product, which is at present almost universally adopted among manufacturers.

ELEMENTS OF STEAM POWER PLANT DESIGN

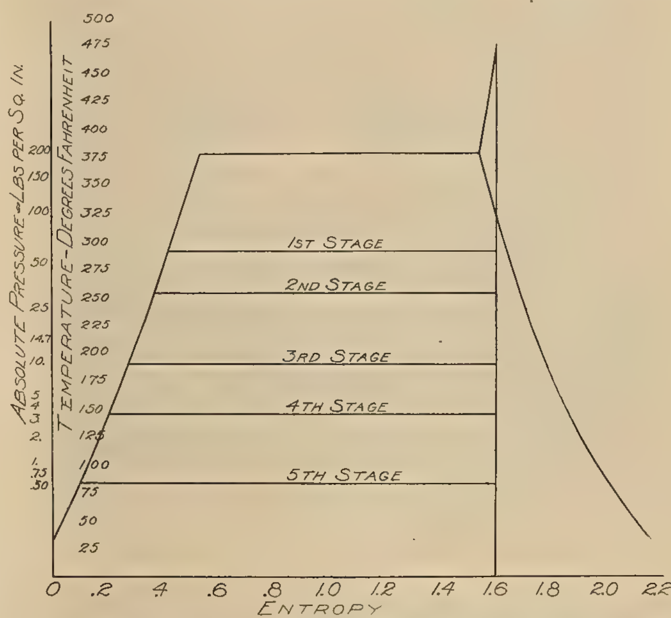
STEAM TURBINES AND BOILERS. II.

BY C. H. DELANEY.

In designing a steam power plant the first thing to be determined is the capacity to be installed. This is determined by the business conditions in the locality in which the plant is to be built; the amount of power used in the vicinity; and the amount of assistance required by the transmission system at times of low water, etc. Having determined on the total capacity of the power plant, the next thing to determine is the number of units to be installed and the size of each. Suppose for instance, it has been decided to build a plant having a maximum capacity of 12,000 kw. and suppose further, it is expected that the maximum of 12,000 kw. will be reached only during the peak of the load in the evening, and that there will be an industrial load in the day time, of 7000 kw. and that the load at other times of the day or night will average about 2000 kw. To suit these conditions we might install a single unit having a capacity of 12,000 kw. or we might install two units, one of 7000 kw. and one of 5000 kw., or again we might install three units, one of 7000, one of 3000 and one of 2000 kw. In order to decide which is the best of these three combinations, it is necessary to consider the load curve of the machines. By this I mean a diagram giving the economy or water rate of the turbine at various loads. If the load curve has a sharp peak giving a good economy for a very small range in the capacity, it is best to install a number of machines of small capacity, rather than one large machine, as we are then able to operate each machine at a capacity suitable to its most efficient load at all times of the day. In the case of steam turbines, however, where the load curve is fairly flat, which means that the machine operates at good economy over a wide range in capacity, it is not worth while going to the expense and complication of installing three or four small machines instead of one large unit. There are serious objections, however, to a large plant having only one prime mover, as this machine must run as long as there is any load whatever to be carried, and if anything goes wrong with it, the plant is thrown completely out of business. If there are two machines of smaller capacity and one of them is to be shut down for repairs, it is still possible to carry half of the load on the other one, and by making the repairs during the hours of light load, they may be carried on without interfering with the operation of the plant to the smallest extent. The cost of the different sizes of machines and of their installation must of course be very carefully considered, but it is probable in the case suggested above, that it would be decided that the best combination to suit the conditions would be to install one 7000 kw. machine and one 5000 kw. machine.



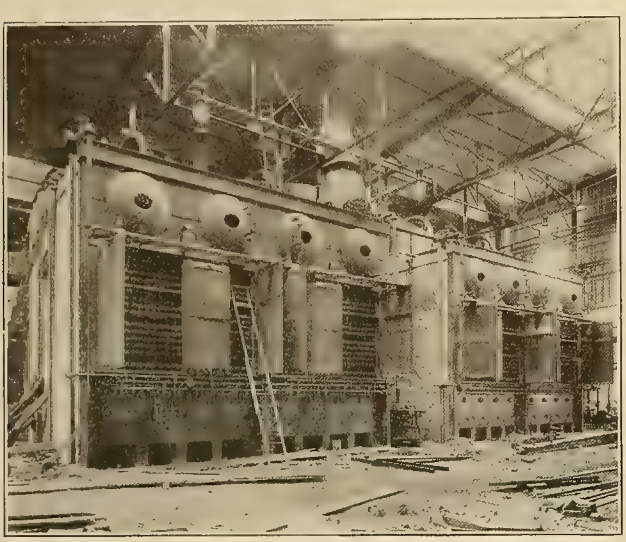
Pressure Volume Diagram for 12,000 kw. Turbine.



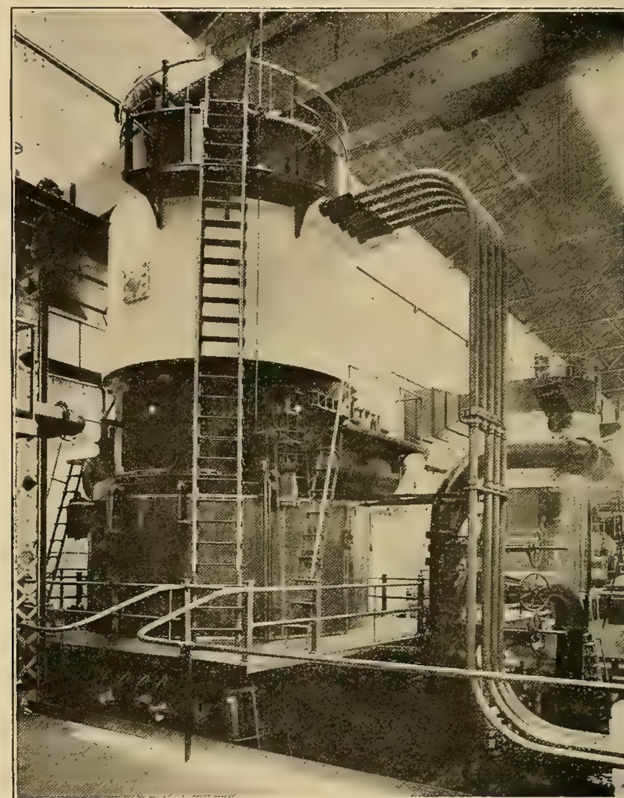
Temperature Entropy Diagram for 12,000 kw. Turbine.

The type of turbine selected will depend to some extent on the size, as certain types are best suited for large sizes and other types are best suited for small sizes. There are certain theoretical problems involved in the design of turbines which have been solved by different manufacturers in different ways. In some types the high pressure steam expands direct in the buckets of the wheels. In others the steam expands first in nozzles designed to convert its pressure energy into velocity energy, so that when it reaches the buckets it has a considerably lower pressure but a much higher velocity than in the first case. Various combinations of these two general types are used by different manufacturers. In determining which is the best machine to install, however, it is not so much the general principles involved that must be considered as the design of the details, such as the methods of fastening the buckets to the wheels, the clearance between the movable and fixed parts, the facility for making repairs and the provision for expansion and contraction due to heat. These are the points that determine the reliability of the machine in operation, and this is the most important consideration in power plant work; for, while high efficiency is something much to be desired, the machine that can be depended upon to carry the load through a critical time is the best machine to install.

Having determined on the size and type of steam turbine to be installed, the next thing to be considered is the boiler capacity required. Boilers are of two general types—water tube and fire tube—but owing to the greater reliability and safety of water tube boilers and the much smaller space they occupy, they are the only ones considered nowadays in large power plants. There are a great many different makes of water tube boilers on the market, all of which produce good dry steam when fired at their ordinary rating. There is a great tendency at the present time, however, toward forcing boilers to very high capacities, which, when combined with intermittent firing results in severe strains in the boiler due to expansion and contraction. The flexibility of a boiler, therefore, which enables it to stand this severe service without excessive strain is the first thing to look for in picking out the make of boiler to be installed. The ease with which the boiler can be cleaned and repaired is also of prime importance. The economy of a boiler depends more on its operation than its design, but it is important to have sufficient furnace volume, suitable area for the gas passages with proper baffling, and a stack of proper dimensions to give the correct draft. The furnace arrangement must be such as to insure perfect combustion of the fuel before the gases strike the heating surface of the boiler, for once the gases are cooled there is no further chance of their burning. Boilers are usually rated on the basis of 10 sq. ft. of heating surface per h.p., one h.p. being taken at 34½ lb. of water evaporated per hour from and at 212 degrees. According to this rating each sq. ft. of heating surface in the boiler will evaporate 3½ lb. of water per hour. While this is the most economical point at which boilers can be operated, it is nevertheless true that a boiler can be forced to evaporate twice this amount or 7 lb. per sq. ft. of heating surface, and inasmuch as the full load of 12,000 kw. is expected for only a few hours each day, it would be more economical to force the boilers hard during the few hours than to fire up a number of additional boilers for the peak load and shut them down again two or three hours later. While 7 lb. evaporation per sq. ft. is too much to figure on in every day operation, it is sate to base the amount of boiler heating surface on an evaporation of say, 5½ lb. per sq. ft. of heating surface at the maximum load. Assuming that the total steam required for the turbine and all the auxiliaries will not exceed 18 lb. per kw.-hr., it would be necessary therefore to install $12{,}000 \times 18 \div 5\frac{1}{2} = 39{,}400$ sq. ft. of heating surface or 3940 boiler h.p. It is necessary, however, to provide sufficient boiler capacity to allow one boiler to be shut down for cleaning purposes. We may, therefore, have 7-650 h.p. boilers of 6-800 h.p. boilers, in either of which combinations we could have over 3900 h.p. in operation and one boiler cut out for cleaning. In this connection it may be stated that the larger the boiler the less it will cost per horsepower to install and the more economical it will be in operation. With boilers that are too large, however, too much additional capacity would have to be installed to allow for cleaning and it is therefore advisable to have not less than six units. Great success has been obtained in Detroit with boilers rated at 2300 h.p. which can be overloaded to such an extent that almost 4000 h.p. may be obtained from a single unit. In the plant referred to, however, there will eventually be installed ten of these boilers, so that each one is only one-tenth the capacity of the entire plant. Two of these boilers would be sufficient to operate the plant we are considering, but if a tube in one of them should blow out, one-half the capacity of the plant would be lost.



Four 770 H.P. Water Tube Boilers in Process of Construction, Oakland.



The Largest Steam Unit on the Pacific Coast.
15,000 Kw. Vertical Steam Turbine, Installed at the Potrero, San Francisco.

TREATMENT FOR ELECTRIC SHOCK.

The National Electric Light Association has compiled the above information through a committee of distinguished experts as follows:

Dr. W. B. Cannon, Chairman, Professor of Physiology, Harvard University; Dr. George W. Crile, Professor of Surgery, Western Reserve University; Dr. Yandell Henderson, Professor of Physiology, Yale University; Dr. S. J. Meltzer, Head of Department of Physiology and Pharmacology, Rockefeller Institute for Medical Research; Dr. Edw. Anthony Spitzka, Director and Professor of General Anatomy; Daniel Baugh Institute of Anatomy, Jefferson Medical College; Mr. W. C. Eglin, Past-President, National Electric Light Association; Dr. A. E. Kennelly, Professor of Electrical Engineering, Harvard University; Dr. Elihu Thomson, Electrician, General Electric Company; Mr. W. D. Weaver, Secretary, Editor, Electrical World.

Aid can be rendered best by one who has studied the rules and has learned them by practice on a volunteer subject.

Instructions for Resuscitation.

Follow these instructions even if victim appears dead.

1.—Break the Circuit Immediately.

1. With a single quick motion separate the victim from the live conductor. In so doing avoid receiving a shock yourself. Many have, by their carelessness, received injury in trying to disconnect victims of shock from live conductors.

Observe the following precautions:

(a) Use a dry coat, a dry rope, a dry stick or board, or any other dry non-conductor to move either the victim or the wire, so as to break the electrical contact. Beware of using metal or any moist material. The victim's loose clothing, if dry, may be used to pull him away; do not touch the soles or heels of his shoes while he remains in contact—the nails are dangerous.

(b) If the body must be touched by your hands, be sure to cover them with rubber gloves, mackintosh, rubber sheeting or dry cloth; or stand on a dry board or on some other dry insulating surface. If possible, use only one hand.

If the victim is conducting the current to ground, and is convulsively clutching the live conductor, it may be easier to shut off the current by lifting him than by leaving him on the ground and trying to break his grasp.

2. Open the nearest switch, if that is the quickest way to break the circuit.

3. If necessary to cut a live wire, use an ax or a hatchet with a dry wooden handle, or properly insulated pliers.

Fig. 1. Inspiration; Pressure Off.

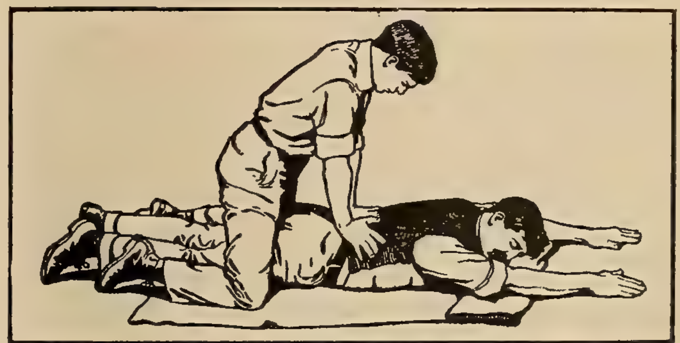


Fig. 2. Expiration; Pressure On.

An accidental electric shock usually does not kill at once, but may only stun the victim and for a while stop his breathing.

The shock is not likely to be immediately fatal, because:

(a) The conductors may make only a brief and imperfect contact with the body.

(b) The skin, unless it is wet, offers high resistance to the current.

Hope of restoring the victim lies in prompt and continued use of artificial respiration. The reasons for this statement are:

(a) The body continuously depends on an exchange of air, as shown by the fact that we must breathe in and out about fifteen times a minute.

(b) If the body is not thus repeatedly supplied with air, suffocation occurs.

(c) Persons whose breathing has been stopped by electric shock have been reported restored after artificial respiration has been continued for approximately two hours.

The Schafer, or "prone pressure" method of artificial respiration, slightly modified, is illustrated and described in the following resuscitation rules. The advantages of this method are:

(a) Easy performance; little muscular exertion is required.

(b) Larger ventilation of the lungs than by the supine method.

(c) Simplicity; the operator makes no complex motions and readily learns the method on first trial.

(d) No trouble from the tongue falling back into the air passage.

(e) No risk of injury to the liver or ribs if the method is executed with proper care.

II.—Send for the Nearest Doctor.

This should be done without a moment's delay, as soon as the accident occurs, and while the victim is being removed from the conductor.

III.—Attend Instantly to Victim's Breathing.

(1) As soon as the victim is clear of the live conductor, quickly feel with your finger in his mouth and throat and remove any foreign body (tobacco, false teeth, etc.). Then begin artificial respiration at once. Do not stop to loosen the patient's clothing; every moment of delay is serious.

(2) Lay the subject on his belly, with arms extended as straight forward as possible, and with face

to one side, so that the nose and mouth are free for breathing (see Fig. 1). Let an assistant draw forward the subject's tongue.

(3) Kneel straddling the subject's thighs and facing his head; put the palms of your hands on the loins (on the muscles of the small of the back), with thumbs nearly touching each other, and with fingers spread over the lowest ribs (see Fig. 1).

(4) With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the subject (see Fig. 2). This operation, which should take from two to three seconds, must not be violent—internal organs may be injured. The lower part of the chest and also the abdomen are thus compressed, and air is forced out of the lungs.

(5) Now immediately swing backward so as to remove the pressure, but leave your hands in place, thus returning to the position shown in Fig. 1. Through their elasticity, the chest walls expand and the lungs are thus supplied with fresh air.

(6) After two seconds swing forward again. Thus repeat deliberately twelve to fifteen times a minute the double movement of compression and release—a complete respiration in four or five seconds. If a watch or a clock is not visible, follow the natural rate of your own deep breathing—swinging forward with each expiration, and backward with each inspiration.

While this is being done, an assistant should loosen any tight clothing about the subject's neck, chest, or waist.

(7) Continue artificial respiration (if necessary, two hours or longer), without interruption, until natural breathing is restored, or until a physician arrives. Even after natural breathing begins, carefully watch that it continues. If it stops, start artificial respiration again.

During the period of operation, keep the subject warm by applying a proper covering and by laying beside his body bottles or rubber bags filled with warm (not hot) water. The attention to keeping the subject warm should be given by an assistant or assistants.

(8) Do not give any liquids whatever by mouth until the subject is fully conscious.

First Care of Burns.

When natural respiration has been restored, burns, if serious, should be attended to until a doctor arrives,

A raw or blistered surface should be protected from the air. If clothing sticks, do not peel it off—cut around it. The adherent cloth, or a dressing of cotton of other soft material applied to the burned surface, should be saturated with picric acid (0.5 per cent). If this is not at hand, use a solution of baking soda (one teaspoonful to a pint of water), or the wound may be coated with a paste of flour and water. Or it may be protected with a heavy oil, such as machine oil, transformer oil, vaseline, linseed, carron or olive oil. Cover the dressing with cotton, gauze, lint, clean waste, clean handkerchiefs, or other soft cloth, held lightly in place by a bandage.

The same coverings should be lightly bandaged over a dry, charred burn, but without wetting the burned region or applying oil to it.

Do not open blisters.

DISCUSSION ON ARTIFICIAL TRANSMISSION LINES.[1]

Clarence S. Hull: I would like to know how on these artificial lines you will duplicate the switching and the charging conditions on 100,000 volt real line? It would be interesting to know how that is done, so that you can take your oscillograms and see what happens when you charge your arresters or throw in and out the line either with high or low tension switches.

H. F. Fisher: That is one of the problems which has not been fully determined in the testing of artificial transmission lines; how you would exactly duplicate some of these conditions. The speed at which you rupture the circuit is determined by experiment and can be readily duplicated in the artificial line. The charging of lightning arresters is a problem that I doubt very much if we can investigate at all on the artificial line. It would seem as though the main difficulty in the past has been the taking care of the large energy flow to which the arrester is subjected when first connected to the transmission system and would thus appear to be a problem in lightning arrester design. The actual line disturbance can be duplicated artificially.

A. J. Bowie Jr.: I would like to ask Mr. Fisher if the tests on artificial lines have developed any results which would not be normally anticipated with reference to transmission lines; whether any particular new facts were brought out, or just confirmation of the old results?

H. F. Fisher: Tests have been too recent in date to fully prophecy possibilities for determining new phenomena. The tests on the lumpy lines show nothing new at all. They simply confirm what we already knew and are suitable only for conditions of steady or permanent energy flow. But there are possibilities, I believe, in the testing of artificial lines for traveling waves, impulses and those things which have not been studied in detail in the past.

Mr. Fries: The question of leakage conductance has been referred to. I would like to find out whether any attempt has been made to introduce leakage conductance into these transmission lines. It seems to me, as far as resistance, inductance and distributed capacity are concerned our theory has been so well verified not only in actual lines but in artificial lines already built that we are really able to foretell very clearly what is going to happen so far as these constants are concerned; but what we are looking to the physical laboratories for more information about is the leakage conductance and the corona. Those are the things that today are most important, because they are not subject to such rigid mathematical calculation as the other phenomena are. Of course, I understand that the effect of corona could not be duplicated today on any artificial transmission line, but it seems to me that the leakage conductance might be taken care of. That is at present the most fruitful field of application for artificial lines; otherwise, they seem to be more of pedagogic interest than useful to the practical engineer; because even transient phenomena can now be so closely followed by mathematical investigation (although it is a rather laborious work) that we really don't need the testing. I would like to know if there was any attempt made to duplicate the leakage conductance? If so, with what results?

H. F. Fisher: As far as I know, there have been no attempts made to accurately duplicate the leakage conductance. You would have a certain control over that by the choice of material and number of condenser sheets, but as far as I know, it has never been attempted to duplicate it with any great degree of accuracy.

Mr. Fries: Corona appears first at a certain critical voltage; consequently these artificial lines, operated at low voltage, don't give us any information about corona. Reading for instance the paper by Dr. Kennelly and Mr. Lieberknecht, I find their results so closely with theory that it seems

[1]The main paper on this subject, by H. F. Fisher, appeared in the Journal of Electricity, Power and Gas, January 11, 1912.

to me nothing further is to be learned from artificial lines except as regards the influence of leakage conductance; but here we would indeed be grateful for numerical results.

A. J. Bowie Jr.: With reference to the opening of switches under load, the number of oscillations required to extinguish the arc is not a matter of any material importance, unless the presence of these oscillations is accompanied with voltage oscillations of undesirable effect. In other words, the fact that the switch will gradually open the circuit is an advantage rather than a disadvantage. It is the cushioning effect that one gets with a properly designed switch, which is a positive advantage in breaking the circuit. The switch shown here—the Townsend Air Break switch—is evidently a switch which was capable of handling the load; so the results obtained therewith cannot be used as an indication of what a switch properly designed would accomplish.

There seems to be no voltage distortion whatever, even with the current distortion which followed; in other words, a very small per cent of voltage distortion accompanied the operation of the switch, even though it did not break the load.

J. P. Jollyman: In considering the question of artificial lines and the question of actual lines and the connected apparatus, we must not forget that the line is only a part of the transmission system; and certain of the characteristics of other parts of the system are very important and have an important bearing on the action of the system as a whole. For instance, in a general way in a long distance transmission system, composed of generators, step-up transformers, line and step-down transformers, the line would have some such constants as a resistance loss from six to ten per cent and an actual drop of twenty to thirty per cent; the transformers, step up and step down, would have a total reactance of not less than eight per cent, so they form a rather important factor in the regulation of the system. The resistance loss in the transformers will be small, perhaps a little less than one per cent, taking them as a whole and at full load. The generators form a very important link in the system and one which is very difficult to control. The reactance in an ordinary water wheel generator is perhaps forty per cent; I have seen some machines with fifty per cent reactance. When it is realized that the same current applies not only to the line but to the generators and transformers, and the power factor may be very far from unity, you can readily see that we have to pay close attention to the effect of the other pieces of apparatus in the system as well as that of the line itself; and I should suggest that in the experimental work which might be done with artificial lines, it might be profitable to consider adding something to represent at least the transformers. The transformers are after all an essential part of the system. We may be able to control the generators in such a manner that we may be assured of a constant 'bus voltage; but there are transformers at each end of the line and you cannot get away from them if the transmission voltage is high.

From a brief consideration of the relative characteristics of the different parts of the system it may be seen that not only is the line important, but in planning a system as a whole, or predicting its performance, you must take careful account not only of the line but the transformers particularly and the generators as well.

Thereupon an adjournment was taken.

A PARTIAL LIST OF VOLTAGES IN CALIFORNIA HYDRO-ELECTRIC PRACTICE.

BY F. J. MASLIN.

Name.	Lgth.	K.V.	Remarks.
American River			Bought by Western States. Sac., Stockton, Placerville.
California & Oregon.			
Coast Co.'s Elect. Co.	97	33	Contemplates raising to 60. Will have some 100 at San Jose.
Edison Elect. Co....			Changed to So. Cal. Edison.
Gt. West. Power Co..	158	100	
Holton Power Co....	33		On aqueduct leading to Imperial Valley.
Humboldt G. & E...	65	30	Bought by Western States Electric.
La Grange P. Co..			Changed to Yosemite P. Co.
Los Ang. Aqueduct..	270	100	Plant projected on Owens River.
	166	33	
Mt. Whitney P. Co..		34	Raised from 17. Contemplate 60.
Monterey Co. G. & E.	18	33	Have new lines projected.
Nevada-California ...	100	55	Operates near Bishop, Polta, Tonopah, Goldfield, Rhyolite,
Nor. Calif. P. Co.....	258	22	Old Sac. Valley P. Co.
	196	60	Bought by Nor. Cal. P. Co.
Total	454	..	Nor. Calif. P. Co.
Ontario Power Co. ..			Bought by Pac. Lt. & P. Co.,
Oro Lt. & P. Co....	12	30	Oro. Lt. & P. Co.
Pacific Lt. & P. Co...			
Pacific Power Co.....			A subsidiary Co. of the Nevada-Calif. P. Co. Not generally known. Plant on Londy Lake; 1500 kw. to Rawhide.
P. G. & E...........	330	60	Distance between most remote points.
	140	60	Distance DeSabla-Oakland.
	1175	60	Total miles of lines 60 kv.
Sac. Valley P. Co...	258	22	Now Nor. Calif. P. Co.
San Joaquin L. & P..		60	
San Joaquin L. & P..		30	Proposed.
Sierra & S. F.......	138	104-94	Bought up Knight's Ferry plant of Stanislaus Consolidated and the Tuolumne Co. W. & El. Pr. Co.
Siskiyou El. P. Co...	169	60	Yreka to Dunsmuir.
Snow Mt. W. & P. Co.	115	60	Ukiah to Napa. Sells to P. G. & E.
So. Cal. Edison......	122	75	Kern River to L. A.
So. Cal. Edison......	75	33	Approx. Dist. Santa Ana, Mill Creek and Lytle plants from L. A.
So. Cal. Edison......	200	..	Dist. bet. most remote points.
So. Cal. Edison......	450	..	Approx. total mileage. May be low.
So. Sierra P. Co.....	237		Buys wholesale from Nev,-Calif. P Co.
Truckee River G. E..	135	60-30(2) 60-33(1)	
Tuolumne W. & E..			See Sierra & S. F.
Utica Gold Min. Co.			Near Angels.
Ventura Co. P. Co...	55		
Western States El...	65	30	Operates line Eureka to Junction City. Bought out American River Elect.
Yosemite Power Co..			

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Treatment for Electric Shock

The click, the drop, bing—it's done!!

Such rapid succession of events catches the unwary wholly unprepared for the emergency. On another page of this issue appears the details of procedure in event of the unheralded apparently fatal electric shock. Too much publicity can not be given to such a matter as this. Long experience has clearly shown that the victim of the electric shock is often not killed outright, though from every outward appearance the body is lifeless. The imperfect contact between the body and the dangerous sources of potential, together with the high resistance offered by the skin of the human being, has saved many a victim from complete disaster, if properly treated by his comrades immediately after the horrifying scene.

Artificial respiration, even over a period lasting as long as two hours has been known by prompt and continued action, to safely bring a victim back to a life of usefulness.

Such being the case, it is clearly up to you, dear reader, to turn at once to page 183 of this issue, and, for all time to come, master the details for such an emergency.

The A. B. C. of Generator Output Ratings

The subject of ratings by various manufacturers still mystifies the layman and often appalls the engineer when he seeks a rational basis whereupon to check the guarantee in an official test. Thus, so long as the manufacturer insists upon guaranteeing a turbo-generator, for instance, under conditions of operation of pressure, vacuum and superheat that are to be reduced to standard conditions largely by rules of the thumb, so long will confidence be lost in the mind of the purchaser.

There are other conditions of rating, however, which are based upon scientific principles and yet often due to the hazy grasp of engineering fundamentals on the part of the purchaser, the true meaning of the rating is wholly misunderstood. The present rating of the output of a turbo-generator in terms of kilo-volt-amperes instead of kilowatts presents such a condition of affairs. Thus, the kilo-volt-ampere output is determined by taking the product of the electrical pressure (measured in thousands of volts) and the amperes of current flowing through the terminal wire; while the kilowatt output, or actual power delivered, is this same product multiplied again by the so-called power factor of the electrical circuit.

Alternating currents and alternating voltages rise and fall many times a second somewhat similar to a child's swing, swaying back and forth with rhythmic beat. Consider for a minute two swings, in which one represents the swelling and dying away of the voltage in a wire and the other the swelling and dying away of the resulting current. If these two swings beat back and forth in unison they are said to be in phase. However, if the second swing encounters a seeming resistance in getting started although it will still beat back and forth in the same time as the other, yet it will always lag behind the former by a definite amount.

Again, with throttle wide open, one may easily, if he disregards the possibilities of arrest, travel forty to fifty miles an hour in an automobile on a properly

constructed level western boulevard. Traveling over the same road, equally well constructed and even with the same power of automobile engine, will nevertheless prove materially less thrilling when climbing a grade of eight to ten per cent. Thus, through no fault of the automobile engine design the speed due to external impedance encountered is materially reduced. Hence the speed of an automobile may well be rated on a level ground basis, and in exactly a similar manner the output of a generator is properly rated when considering the energy that may be pumped into an alternating current network containing no inductive effects.

Since alternating current networks as a rule seldom pulsate with voltage and current actually in phase, due to the inductive resistance of the circuit, such a thing as zero angle of displacement is somewhat of a fiction. From elementary trigonometry we learn that the cosine of zero angle is unity and since the cosine of this displacement angle is defined as the power factor it is evident that unity power factor rarely occurs.

The output limits of a generator depend more on its capacity to dissipate heat than on any other factor. Certain of these heat generating variables depend upon the current involved, while others such as hysterisis losses vary as a function of the voltage. It is clearly evident, then, that a generator should not be penalized because it must pump energy into a network having less than unity power factor. Hence, since 80 per cent represents fairly average power factors, it has been found more representative to rate the dynamo output on a kilo-volt-ampere basis.

Much Needed Water Right Legislation

Three features in water right legislation, hitherto unrecognized officially, although tried out informally in several Western states, may well be put upon the statutes. First, there should be a statute compelling the rotative use of water in irrigation where such procedure is necessary for the highest use; secondly, the exchange of water should be legalized; and in the third instance, the several states should exert themselves more forcefully by appropriating sufficient moneys to gather accurate and reliable data on the most promising power sites still undeveloped and within the confines of the commonwealth undertaking such investigation. A detailed discussion of these three proposals will prove of profit and interest to all well-wishers of Western enterprise.

It has been established in the irrigation art that what is known as 2/5ths of a miner's inch of water is amply sufficient, if properly applied, to irrigate an acre of arid land. Such a quantity of water legally defined in the majority of Western states amounts to about five gallons per minute. In the good old days when the farmer had at his disposal 160 acres of land this would give him some sixty miner's inches of water or about 800 gallons per minute. By those who have in person experienced the vicissitudes of modern irrigation on a warm dry day, the decision is unanimous that to attempt to use less water at one time, even though but one acre is to be irrigated, is to waste in dry conducting ditches the major portion of the application. In recent years intensified farming has justly taken its place in western development. A ten-acre tract and even less is found under highest scientific development to adequately support an entire family. Picture, if you will however, anyone endeavoring to irrigate a ten-acre tract with a head of water equal to 5 gallons per minute. Like the windage and friction losses of the dynamo on light load, by far the major portion of the valuable application is lost without power generation. In Southern California, even 1/10th of a miner's inch of water is found sufficient per acre, where the most improved methods are utilized. Hence it is clearly evident that where necessary for the common good, the irrigationist should be compelled to rotate his water right to his neighbors and in return receive his application compounded in sufficient proportions for the highest use with minimum water supply.

To legalize the exchange of water is to accomplish a similar result. Many of the early appropriations take waters of a stream upon the low lying lands tributary thereto. The higher bench lands, though unthought of at first, have in recent years proved more valuable agriculturally. To get water upon these higher lands often requires an exchange. Thus the newcomer may often convey, economically, water to the low lying lands from another source and by an exchange for these waters, he may bring the older right upon his higher bench without in any way interfering with the quality and quantity of supply of his older neighbor. Such exchanges for the common good should under proper restriction be legally recognized.

Again, definite authentic data on the possible water power developments is of such public concern that a commonwealth is indeed putting its funds to the highest use when its moneys are appropriated to gather such information. A cautious procedure looking to only those sites of well-known natural possibilities should at first be attempted. The cost of such an undertaking may with justice be levied against the site to be liquidated when developed. Thus an opportunity will be given, both to the public and to the capitalist, to be fully informed on the possibilities of the particular project. The legislatures of Oregon and Washington both have under consideration the appropriating of $50,000 each for a full investigation of The Dalles of the Columbia River. Congress will also be asked to contribute a similar amount. Here is said to be located some half million electrical horsepower, greater in total than the world-beating Keokuk project now under way on the Mississippi. A preliminary investigation of the state engineer of Oregon, as appeared in our last issue, shows, too, that the ultimate development charges per horsepower may be expected to run far less than the Mississippi installation. The fact that present demands for power are wholly inadequate to utilize such vast powers is no legitimate reason why such investigations should not be undertaken. The industries of the world yearn for the happy hunting grounds of the West. Only through greatest economy of power development can such industries live. Let the world at large once have definite authentic data on the abundance of cheap power development and the future of the West as a manufacturing and industrial center is assured.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Geo. J. Henry Jr., consulting hydraulic engineer, is visiting the Pacific Northwest.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company, is at San Francisco.

S. E. H. Smith, representative of the Sunbeam Lamp Company at Vancouver, B. C., is visiting California.

H. Pim, representative of the Canadian General Electric Company at Vancouver, B. C., is at San Francisco.

F. E. Lehman, stores manager for the Western Electric Company at Los Angeles, was at San Francisco during the past week.

Theo. F. Dredge, Pacific Coast representative of the Pittsburg Piping & Equipment Company, is making a two months' Eastern trip.

J. C. Boyle, engineer in charge of the California-Oregon Power Company's new power plant, on the Klamath River, was at San Francisco during the past week.

Ralph L. Phelps, Pacific Coast manager of the Safety Insulated Wire & Cable Company, recently returned to San Francisco from a visit to the Eastern factory.

E. K. Patton of Chicago, western manager of the Bryant Electric Company, is at Los Angeles and will attend the meeting of the electrical jobbers at Del Monte, Cal., February 27, 28.

Louis C. Kelsey, consulting engineer, Portland, has been engaged to design a municipal lighting plant for Albany, Oregon, which will include a steam electric generator and 600 cluster light posts.

H. V. Carter, president of the Pacific States Electric Company, returned to Seattle from San Francisco this week upon receipt of news that their new Seattle house had been damaged by acid and water from a fire in the same building.

H. E. Sanderson, Pacific Coast manager of the Bryant Electric Company, and **Miles Steel** of the Benjamin Electric Company, have been appointed Jovian statesmen at large by **Frank E. Watts**, Eleventh National Jupiter of the Jovian Order.

Ralph D. Mershon, president of the American Institute of Electrical Engineers, has returned to New York City, after spending some time investigating the proposed transmission line construction of the Oro Electric Corporation in California.

Charles S. Johan, commercial manager and assistant engineer of the Federal Light & Traction Company, is at Deming, N. M., to confer with **Frank Monser**, manager of the Deming Ice & Electric Company, regarding line extensions into adjacent agricultural districts.

Herbert H. Cudmore, president of the Brilliant Electric Company, has been selected as arbitrator in charge of the department of arbitration of the National Quality Lamp Division of the General Electric Company, with headquarters at 30 Church street, New York City.

E. B. Strong, president and general manager of this journal, has returned from the East, where he attended the meeting of the transportation committee for the N. E. L. A. meeting at Chicago in June of this year. He reports great interest in the proposed special train from the Pacific Coast. He also attended the convention of the electrical jobbers at Buffalo.

R. B. Elder, Pacific Coast representative for the Ideal Electric & Manufacturing Company and the Moloney Electric Company, has returned to San Francisco from Marshfield, Ore., with the contract for complete motor equipment for the Coos Bay Pulp & Paper Company, one of the interests of the C. A. Smith Lumber and Manufacturing Company. This order aggregates 1060 h.p. in 18 heavy duty type induction motors, the largest being 200 h.p.

Alfred Still, who lately resigned his position as chief electrical engineer to the Mines Department of the Algoma Steel Corporation of Sault-Ste.-Marie, Ontario, Canada, has taken up a position at Purdue University, La Fayette, Ind., where he is in charge of the courses in electrical design at the school of electrical engineering. Mr. Still is a member of both the British and American Institutes of Electrical Engineers. He has made a special study of hydroelectric developments and transmission line problems, and has only recently returned from the Pacific Coast and Colorado, where he visited many of the important power systems. He is well known to the readers of this journal by reason of the excellent articles he has contributed in the past.

W. W. Briggs has resigned as assistant general sales manager of the Westinghouse Electric & Manufacturing Company, in charge of Pacific Coast territory, to join the Great Western Power Company. His official title has not yet been determined but he will devote his ability to increasing the company's current consumption. Mr. Briggs is one of the best known men in the electrical business on the Pacific Coast and mutual congratulations are being exchanged with regard to his new affiliation. He began his electrical career in 1886 as shop boy in the arc lamp repair department of the California Electric Light Company. Later he joined the Electric Improvement Company. In 1893 he went to Idaho as electrician with a mining company. In 1896 he joined the sales force of the Fort Wayne Electric Company at San Francisco, leaving them to join the sales department of the Westinghouse Electric & Manufacturing Company in 1899, where his advancement was most rapid, culminating in his appointment to the position just resigned in July, 1911.

MEETING NOTICES.

ENGINEERING MEETING AT SPOKANE.

On February 19-21 a general engineering and scientific meeting was held at Spokane, Wash., by the members and associates of the several societies there represented, this being held in place of the Second Annual Northwest Mining Convention.

The meeting was called to order on Wednesday morning by J. C. Ralston, who stated the objects and purposes of the meeting as being to promote more active co-operation, better practice, a higher code of ethics and to encourage the individual to become identified with the engineering or scientific organization which will be most helpful to him. The delegates were welcomed to the city of Spokane by Mayor W. J. Hindley.

A most interesting and comprehensive program of papers was presented on various phases of civil, mechanical, electrical and mining engineering as well as chemistry, forestry and education.

San Francisco Jovian Club.

The San Francisco Jovian Club held an enthusiastic luncheon on February 18 at Tait's Cafe, with an attendance of 65 members. F. H. Woodward presided. The principal business transacted was the adoption of the revised constitution of the Electrical Development League as the constitution for the local Jovian club. This is in accordance with the plan to merge the two organizations. It was also agreed that a nominating committee be appointed to nominate a new set of officers for the "Electrical Development and Jovian League" as the organization will be hereafter known. Mr. Nightingale then entertained the members with a most mystifying exhibit of sleight of hand.

Portland Jovian Luncheon Club.

There were 42 members of the Jovian Electrical League present at the weekly luncheon at the Hazelwood Thursday, February 6th. H. V. Carter, president of the Pacific States Electric Company, spoke on co-operation. L. F. Harza, spoke about the nitrate industry of Norway and the possibility of its production in this country providing electric power could be obtained cheap enough to compete with the foreign product. Mr. Harza stated that the natural product of Chili would last about fifty years at the present rate of consumption, which is increasing about 10 per cent per year. Messrs. Geo. Boring, Burnett Goodwin and Mahoney were appointed as a committee to investigate new quarters for the weekly luncheons. Messrs. Geo. Barker, C. R. Dederick and A. V. Olsen were appointed as the financial committee of the Jovian Electrical League, to devise a scheme to raise the necessary money to take care of the expenses of the League.

The Jovian Luncheon Club held its last luncheon in its present quarters in the Haelwood Grill, on February 13, and from now on will meet at the new Hotel Oregon. Mr. G. L. Priest, was chairman of the day, the meeting being devoted to "General Business."

Oregon Technical Club.

At the meeting of the Oregon Technical Club on February 11, Mr. Joseph Jacoberger of the American Institute of Architects, acted as chairman. Mr. W. H. Crawford outlined the new policy of the club as follows: "That a chairman will be appointed for each month and that he will choose his successor for the succeeeding month. Commencing with February 25, 1913, the luncheon will be held at the Portland Commercial Club. It is the desire of the joint committee who are managing the club to be able to make out a schedule for a number of meetings in advance and they desire the chairman of each body represented to hand in suggestions to the joint committee. The meeting of the 18th will be under the direction of the Oregon Society of Engineers, and the meeting of the 25th under the direction of the A. I. E. E. In the future the meetings will be held promptly at 12:10 p.m. and brought to a conclusion if possible at 1:25 p. m."

The subject of the meeting was "Pertinent Legislation," being a discussion by D. L. Williams, architect, on the proposed amendment to the "Lien Law." The main point being that the new law will require material dealers to notify owners of material delivery to jobs. Under the present law this is not necessary, and owners are at the mercy of unprincipled contractors, architects, and material men. Mr. L. F. Danforth, secretary of the Builders' Exchange, also endorsed this new amendment. Mr. E. F. Lawrence, architect, spoke in favor of the law before the legislature known as the "Excess Condemnation Bill." He pointed out that this law was a success in London, Paris, and about ten states of the Union. The club will give its "House Warming" dinner to members and their guests Saturday evening, February 22, at 247½ Start street. This will be the formal opening of its club rooms to its members, who number about 400 men in all branches of the engineering and architectural professions. A splendid time is assured as a special program has been provided with a keen eye to fun making.

Seattle Section A. I. E. E.

The February meeting of the Seattle Section of the American Institute of Electrical Engineers was held February 18th, in the assembly room, Chamber of Commerce, eighth floor, Central Building. The meeting was devoted to consideration of railway matters with particular attention to railway motors and control equipment. A short paper was read by Mr. A. A. Miller of the Westinghouse Company, followed by an illustrated talk by K. A. Schaller. About fifty stereopticon slides were shown, illustrating recent types of railway equipment. J. D. Ross is chairman and M. T. Crawford, secretary.

Oregon Society of Engineers.

The Oregon Society of Engineers held annual meeting and banquet at the Commercial Club on Thursday evening, February 13. Ninety members and guests were present. In the absence of President Henny, his annual address was read. Vice-president Wm. S. Turner presided and at the close of dinner called out many good toasts from apt speakers; among the guests responding were Mr. Elgin Stoddard of San Francisco, who was strong on "Our Pacific Coast Spirit," and Jos. F. Kinder, president of the Progressive Business Men's Club, who ably championed "United Effort of Clubs."

Dinner was followed by executive session, which disclosed the election of officers as follows: President, Walter H. Graves; Vice-presidents (term expiring 1916) W. H. Crawford, (term expiring 1914) John H. Lewis; Secretary, O. E. Stanley; Treasurer, Henry Blood; Directors (term expiring 1915) D. C. Henny, J. R. Townsend, (term expiring 1916) F. A. Naramore, Douglas W. Taylor, H. L. Vorse; Nominating Committee, Fred A. Ballin, C. E. Condit, Robt. S. Edwards, Louis C. Kelsey, E. B. Newcomb, Frederick Powell, Lewis I. Thompson, Fred D. Weber. Three applicants were admitted to membership.

The society has shown a substantial growth and proved beyond all doubt that it is on a sound footing and is destined to take its place among the most progressive, and therefore the most useful, technical associations of America.

San Francisco Section A. I. E. E.

A meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held in Native Sons' Hall, 430 Mason street, on Friday evening, February 28, at 8 o'clock. The meeting will be preceded by a $1.00 table d'hote dinner at Jules Cafe at 6:30 p. m. A paper on "Operation of Transmission Systems" will be presented by Lee Hagood of the General Electric Company.

This paper will deal with the question of controlling the wattless, or idle, current in transmission lines and large feeders, so as to obtain uniform voltages at the desired values. This can be accomplished by synchronous machines located at the distribution centers controlled automatically with voltage regulators. By arranging the voltages at the generating stations at values somewhat near those to be maintained at the distribution centers, the power factor is also maintained at somewhere near unity power factor over a range of load from about half the peak load to the full peak load. This will effect the maximum use of the available k.v.a. capacity of the generators, transformers and transmission lines involved, which offers considerable flexibility in loading the generator unit efficiently, and, since the voltage is maintained practically uniform over the transmission lines, the necessity of taps on the main transformers is obviated.

The first part of the paper will take up the problem of a system having a small amount of charging current but a large inductive load, and the second part will deal with a system having high voltage transmssion lines, in which the charging current is of considerable magnitude. It will be shown that the problem in the two cases is quite similar.

Some data will be given, obtained from tests made by the author on the system of the Utica Gas & Electric Company. This will be substantially a resume of the author's article published in the General Electric Review of last December. The analysis of the problem as set forth in this article will be extended, to cover systems having long transmission lines. A method of calculation will be shown for long transmission lines, where distributed capacity and inductance must be considered, by which the amount of wattless k.v.a. can be determined for different loads that must be supplied by the synchronous machinery in order to maintain constant voltage drops.

There will be about 35 lantern slides used to illustrate the points brought out in the paper.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

STANDARD SPECIFICATIONS FOR WIRING BUILDINGS.

(Continued.)

A Specification, which with the accompanying drawings, describes the work to be performed and the materials to be used in the construction and installation of the electric light and power wiring for the .... on .... streets, to be constructed for ...., Portland, Oregon, from the drawings and under he supervision of

....

Architects.

Instructions to Bidders.

(1) Bidders are required to make their own estimates of quantities upon which to base their proposals, and are expected to thoroughly familiarize themselves with the intent and meaning of these specifications, as well as with the accompanying drawings, and make their own estimates of the facilities and difficulties attending the execution of the work.

(2) It must be understood that no claims will be allowed against the owners on account of any discrepancy in such estimate so made by bidders.

(3) It is the intention of these specifications to provide a complete system of electric light and power wiring required for the building, and everything necessary to provide a continuous electrical circuit from the service outlets to the farthest lamp outlet is to be included even though not specifically mentioned therein.

(4) The contractor is to furnish all materials necessary to complete the wiring of the building as per the true intent of the plans and specifications whether all the items are fully described and shown or not, it being understood that the plans are not wholly complete and that in their development a reasonable latitude is to be allowed.

(5) This contractor shall read the entire specifications in order to properly figure on all items that may appear relative to the work.

(6) In case these specifications are in any part deficient or not clearly expressed, the parties making the bids shall apply to the architects in writing for the required information before submitting their bids.

(7) Any sub-bidders figuring on any one or more subdivisions of the work shall include the general conditions wherever applicable to his part of the work.

(8) The architects reserve the rights to reject any or all bids.

(9) Drawings and specifications are to be returned to the architects with the bids.

(10) Changes to the plans and specifications may be made by the owners or architects from time to time, as they desire, and they shall in no way effect the contract, but the additional charge for making such changes in the work shall be figured and agreed upon by the architects in writing, and the contractor shall make no changes nor deviations from the plans and specifications unless so authorized in writing.

(11) The contractor shall protect all portions of the building and work during construction and shall make good any injuries to same caused by his operations.

(12) The contractor shall remove all rubbish resulting from his operations.

Time.

(13) The electric lighting contractor will be required to install that part of his work that is to be concealed in the walls or between floors and ceilings, and other rough work, in conjunction with the other buildings trades, and at such times as the progress of the other building operation will admit and require, and to install the finished work at such time as the progress of the interior finish of the building will admit, and as directed by the architects the entire work to be finished by the time to be determined and stated in the contract.

Contract.

(14) The form of contract to be signed by the contractor will be the regular building contract form prepared and used by the architects.

Drawings.

(15) The general building set of plans, comprising the floor plans, elevations, sections and large scale shall constitute the drawings illustrating the work required by this specification.

(16) Most symbols shown on drawings are those adopted by the National Electrical Contractors' Association.

(17) After the contract is let the electric lighting contractor shall prepare and submit to the architects for approval a complete set of working plans showing the method of running all circuits, the location of all outlets, switches, cutouts, etc., together with sizes of all mains and branches. For this purpose the architect will furnish a set of blue prints on which these plans may be drawn with colored pencil.

Capacity of Conductors.

(18) All switches and conductors, including service mains, feeders and branch circuits, are to have a conductivity of not less than 98 per cent (Matthiessen Standard) and are to be of such size that, when carrying full connected load, the maximum drop in pressure from the point where the service enters the building to the farthest lamp or power outlet will not exceed 2 per cent for lighting 4 per cent for power, and in no case is the current density to exceed 800 amperes per square inch of cross section.

(19) All bidders must specify in their bids the sizes of the service mains, various feeders, branch circuits, switches, and cutouts that they propose to install.

Tests.

(20) After completion of the electrical work, the architect will cause such tests to be made of the electrical installation as may be considered necessary. If the results of these tests show that the work does not comply with the requirements of the specification the wiring contractor shall immediately make all changes necessary to put the work in proper condition and shall pay the expense of all subsequent tests or inspections required to determine whether or not the work is satisfactory.

Material and Workmanship.

(21) All electrical apparatus and material to be of the best grade of standard manufacture, and approved by the Board of Fire Underwriters.

(22) The bottoms of all switch and cutout cabinets are to be inclined downward and out at an angle of 44 degrees to prevent the storing of ignitable material in such cabinets.

(23) All methods employed to be thoroughly modern and up to date and in all ways satisfactory to the architects and the wiring contractor agrees to replace any part or parts showing defects in workmanship or material during the period of twelve (12) calendar months from the date of acceptance.

Inspection.

(24) The general and all sub-wiring contractors will be required to comply with all city and state requirements and those of the Portland Railway, Light & Power Company.

(25) All work shall be installed in strict accordance with the latest edition of the "National Electrical Code" as adopted by the National Board of Fire Underwriters, and a certificate of inspection is to be obtained and paid for by

the contractor and delivered to the architects before final payment shall be made.

Note—The numerical clauses under the next heading "System" are general and may be applied in any specification; the alphabetical clauses are special, and the party writing the specifications must make a selection of the one meeting his requirements.

System.

(26) The building is to be wired for lighting on the balanced three-wire system having 117 volts between neutral and outside legs; and for power on the:

(a) Two-wire direct current system having ...... volts between wires.

(b) Three-wire three-phase alternating current system having 234 volts between any two wires.

(27) The mode of wiring to be that known as:

(a) Concealed metal conduit work, as all wires are to be run in galvanized iron conduits, same to be concealed in walls and between floors and ceilings.

(b) Exposed metal conduit work, as all wires are to be run in metal conduits, same to be placed on exterior of ceilings and walls.

(c) Concealed knob and tube work, as all wires are to be run concealed in walk and between floors and ceilings and to be supported by knobs and tubes.

(d) Moulding work, as all wires are to be run in moulding fastened to the ceilings and walls.

(e) Exposed or open work, as all wires are to be exposed on ceilings and walls (where such construction will not be in violation of the National Electric Code) and supported by knobs and cleats. (Cleats being preferred).

Note—The following are a few examples of how the detail specifications may be written for various classes of buildings and for different modes of wiring, the examples being arranged according to the superiority of the class of work, the highest grade of work coming first.

(To be continued.)

CONTRACTORS' NOTES.

Cohn Bros. of Portland, Oregon, are constructing a six-story re-inforced concrete building on the northeast corner of Yamhill and Third streets. The electrical installation is being done by the McPage, McKenney & Company, electrical contrastors and engineers of Seattle, Washington.

Morgan, Fleidner & Boyce are constructing an eight-story reinforced concrete building on the east side of Washington street, near Seventh street, Portland, Oregon. It is built especially for physicians and dentists. To provide ample capacity to take care of the electrical equipment of the up-to-date physicians' and dentists' offices, each room will be equipped with a power circuit of 50 amperes, if necessary. The scheme adopted is to run the conduit large enough to accommodate conductors to supply this capacity if needed. The circuit wires of the power circuits will not be placed in at the time of the construction, but will be "pulled in" from time to time as the occasion demands, consequently the only extra expense incurred in the original contract is the difference in cost of ½ in. conduit and ¾ in. or 1 in. conduit and a small additional labor cost.

This idea should be adopted in all office buildings and a great deal of future trouble and expense would be avoided, also better service given to the tenants. The electrical work is being done by their own electricians.

The new Majestic Theater, in Portland, Oregon, is scheduled to open on February 24, 1913. This is a fire-proof structure throughout, and the electrical installation was installed by Meecham & Babcock of Seattle, Wash.

BOOK REVIEWS.

Essentials of Electricity. By W. H. Timbie. Size: 5 in. x 7 in.; 263 pages; 222 illustrations; cloth binding. Published by John Wiley & Sons of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $1.25.

This book, one of the Wiley technical series, is in the nature of a textbook for wiremen and the electrical trades. The author, who is head of the department of applied science at Wentworth Institute, has developed his text from notes used in short trade courses for students who wish to advance themselves in one or another of the electrical trades. The book treats first of the elementary principles of electricity and then proceeds with various methods and combinations of electric wiring. Generators, motors and batteries reecive also a proportionate share of treatment. The chapter on locating and correcting trouble is especially useful. The theory and information are presented clearly and forcibly, unclouded by a mass of foreign matter. The book will be found especially useful to men in the electrical contracting business and allied electrical trades.

Electrical Machine Design. By Alexander Gray. Size: 5½ in. x 8½ in; 528 pages; 317 illustrations; cloth binding. Published by McGraw-Hill Book Company of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $4.00.

This book on the design and specification of direct and alternating current machinery, representing the practice in vogue at McGill University, is compiled from a mass of material which the author found necessary to tabulate during several years of experience as a designer of electrical apparatus. The book is divided in logical sequence under four main headings: Direct current machinery, alternators and synchronous motors, polyphase induction motors, and transformers. The procedure in design and the special problems completely outlined and then solved in detail are especially helpful. A summary of symbols is contained in the rear of the book, which, together with a comprehensive index of twelve pages, makes the labor easy when using the book as a reference for knotty problems in design. The book is indeed a most useful one, both as a reference for the designer and for the student who desires to master the elements of the art in electrical machine design.

Water, Its Purification and Use in The Industries. By William Wallace Christie, consulting engineer. Size: 5 in. x 7½ in.; 219 pages; 79 illustrations; cloth binding. Published by D. Van Nostrand Company of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $2.00.

This book treats of water and its purification for use in the industries. Water for drinking purposes is, however, touched upon in its pages. The author, who has previously published many technical articles dealing with the subject, especially a book on scale corrosion and foaming in boiler waters, speaks with the authority of experience. Various processes of water softening are discussed, including a dessertation on aeration, sterilization, ozone and ice. By a liberal employment of illustration, the author has made a feature of the mechanical devices utilized in the purification of water. Numerous authorities are quoted and analyses collected from widely varying sources add force to the arguments presented. Much of the material appeared as a series of articles in a recent widely known technical paper, consequently the theories have stood the test of recent discussion.

Steam Boilers. By E. M. Sheally. Size: 6½ in. x. 8½ in.; 356 pages; 185 illustrations; cloth binding. Published by the McGraw-Hill Book Company of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $2.50.

The general subjects treated are types of boilers, boiler calculations and design, effects of heat and properties of steam, fuels and boiler accessories. Inspection and testing of boilers are also dealt with within its pages.

INDUSTRIAL

GAS-ELECTRIC MOTOR CARS ON CHICAGO, MILWAUKEE & PUGET SOUND RAILWAY.

The Chicago, Milwaukee & Puget Sound Railway Company has recently placed in service two General Electric Company gas-electric motor cars on branch lines in the State of Washington. One of these cars, No. 300, is operating between Everett and Monroe, a distance of 14 miles, and makes five single trips per day, totaling 70 miles; while the other car, No. 301, runs from Seattle via Cedar Falls to Enumclaw, a distance of 62 miles, and makes one round trip each day, covering 124 miles.

The cars are of the combination passenger, smoking and baggage compartment type. They are 70 ft. 5 in. long, 10 ft. 5 in. wide, weigh approximately 50 tons and have a total seating capacity for 77 people. The cab in front containing the power plant apparatus measures 11 ft. 11 in. long; next is the baggage room, 15 ft. long; then the smoking section, 10 ft. 11 in. long; and the passenger compartment, 27 ft. 5 in. long. A center vestibule with side entrances runs crosswise between the passenger and smoking compartments. The smoking section provides for twenty, and the passenger compartment for fifty-seven of the total seating capacity. The roof and rear are of the "turtle back" design.

Chicago, Milwaukee & Puget Sound Gas-Electric Motor Car.

The generating unit is the standard type and is located above the floor line of the cab, free from dust and dirt and under immediate observation of the engineer. It consists of an 8-cylinder, 4-cycle gas engine of the "V" type, direct connected to a 600 volt, commutating pole electric generator, designed to meet the special conditions the service demands. Flexibility of control and economy of operation result from electrical transmission of the power. Starting the engine is effected by compressed air taken from the main reservoirs of the air brake system, which are built with surplus capacity for this purpose. The main air compressor is driven from the crank shaft of the main engine, and is fitted with an automatic governor which maintains a constant pressure. The engine can rotate at normal speed, irrespective of the speed of the car, and deliver its maximum power, a feature of great advantage on grades, in case of snow storms, or other emergency conditions.

An auxiliary equipment is also provided, consisting of a 2-cylinder, 4-cycle gas engine direct connected to a single cylinder air compressor and lighting generator. The function of this set is to supply an initial charge of air for starting the main engine and to deliver power for lighting the car. The set is started by hand.

The control is simple, substantial and similar to that of any standard electric trolley car. Mounted on the axles of the forward truck are two GE-205, 600 volt, box frame, oil-lubricated, commutating pole railway motors of 100 h.p. each. Years of experience have demonstrated that no piece of apparatus is less liable to derangement than the railway motor built for heavy, high speed traction work. By means of a special controller the motors are placed progressively in series and parallel connection.

The controllers are also arranged for governing the motors by shunting the fields in obtaining the desired final speed acceleration. This auxiliary method of control assures greater operating efficiency through continuous saving of power, economy effected by decrease in the weight of the equipment and an increase in the service capacity. Two extra points are provided on the controller for final speed acceleration in parallel, whereby the motor fields are shunted and weakened. The resulting higher armature speeds permit the use of smaller pinions, and full utilization of the power input is secured throughout the entire speed range, from start to full speed.

Energy is transmitted directly without the intervention of mechanical change speed gearing. The voltage is governed by varying the strength of the generator field, which is accomplished by the movement of a single handle on the controller, and the resultant speed changes of the motors produce a smooth and rapid acceleration without rheostatic power losses or gear changes. Separate handles are provided for throttling the engine and for reversing the car. The latter is accomplished instantly by changing the motor connections in the usual manner without stopping the engine, which always rotates in the same direction. This allows the cars to be brought to a halt quickly independent of the brakes in an emergency. All the levers are located within convenient reach of the operator. The radiators are placed on the roof and circulation for cooling the engine is maintained by the thermo-siphon system.

The trucks are of the swing bolster type with elliptic bolster springs and coil equalizer springs. The bearings, treads and flanges of the wheels and axles conform to the standards of the M.C.B. The brake equipment includes hand brakes in addition to the combined straight and automatic air brakes. A high power Mazda incandescent headlight and reflector, and air whistle and pneumatic gong are provided. A hot water heater, coal fired, is installed for heating the car. To prevent freezing in cold weather when the car is lying idle, the heater circulation may be connected to the engine cooling system. A 150 gallon gasoline tank for the power supply is suspended under the car. While the engine is running the gasoline is pumped automatically; and when starting, by a hand pump.

It is interesting to note that these cars made the long trip across the western continent under their own power. Car. No. 300, operating between the terminals Everett and Monroe, left Chicago on the Chicago, Milwaukee & Puget Sound tracks and covered the distance to Tacoma, Wash., 2201.2 miles, in ten days, daylight running. While this is probably the longest single run of a self-propelled car, it is not exceptional, as similar records are being duplicated every day by cars of this type in actual service.

Necessarily, the special schedules of the motor cars while on the trip were subject to the exigencies of regular traffic requirements; and numerous blocks, slowdowns and lay-overs were encountered. The car in question averaged 220 miles per day, and one day covered 315 miles. A run from Malden to Othello, Wash., 103 miles, was made in 2 hours and 10 minutes, and in one case 20 miles of 2.2 per cent grade were negotiated in 56 minutes with one stop.

THE TELEPHONE IN THE WILDERNESS.

In writing of his experiences during a recent vacation trip in the heart of the snow-clad Rockies, W. P. Sidley, vice-president and general counsel of the Western Electric Company gives a striking illustration of one of the many phases of usefulness of the government's forest service telephones. After describing the beginnings of the trip, Mr. Sidley goes on to say:

"While at Paint Rock Lakes, a forest ranger rode into camp one afternoon with a message sent that same morning from Chicago, stating that Arthur D. Wheeler had died suddenly the previous evening. To appreciate this remarkable performance, it should be remembered that the party had left the last point of communication with the outer world, viz.: Horton's Ranch on the east slope of the mountains, ten days before, had traveled north and west over the crest, and were then camped in the wildest part of the west slope some five days distant from East Tensleep Lakes, the next point of communication with Horton, where he was to bring us fresh supplies on September 4th. Under ordinary circumstances it would have taken from three days to a week to have located the party and delivered this message from the ranch. An extraordinary incident, however, brought about its delivery within a few hours after it was filed at Chicago.

"The Paint Rock region of the Big Horns lies within the forest range territory assigned by the government to Mr. O. A. Emery. This district is some fifty miles north and south, and about twelve miles in width, with its western edge overlooking the Big Horn basin. On the morning of August 30th, the ranger was out on a high rim of rock near his home examining the surrounding country through a powerful field glass in search of possible forest fires, when his eye caught sight of a sorrel horse feeding on the shore of Paint Rock Lake six miles away. He watched the horse closely and concluded from the manner in which it stood after feeding, that it was not one of the range horses that graze in a semi-wild state over this region, but belonged to some party of campers or 'tourists,' as they are called in that country.

"Almost immediately upon returning to his cabin, he received a call on his telephone asking him if he knew anything of Mr. Sidley's whereabouts in his district and stating that an urgent message was awaiting delivery. The message, which was then given him, had been telegraphed at Buffalo, Wyoming, phoned to Horton's Ranch, relayed from there in the same manner to Sheridan, from Sheridan across the Big Horns to Basin City, from there to Hyattville at the foot of the west slope and thence up the mountains to the ranger's cabin, where it was received over the Western Electric equipment that is used throughout this government service."

TELEPHONES ON THE OREGON ELECTRIC RAILWAY LINES.

The latest electric railway system of the Northwest to adopt the telephone for dispatching its trains is the Oregon Electric Railway, which recently opened its new line from Portland to Eugene, and also operates from Portland to Forest Grove. The former traverses the heart of the famous Williamette Valley which is the richest and most productive portion of the entire state of Oregon as far as agricultural resources are concerned.

The telephone train dispatching apparatus with which the road is to be equipped will be supplied by the Western Electric Company. Two circuits will be equipped, one from Portland to Forest Grove and the other from Portland to Eugene. The former division is approximately 40 miles, while the other is approximately 125 miles in length. There are to be two train dispatchers at Hoyt Street Station, Portland.

The apparatus to be used includes two complete dispatcher's equipments comprising key cabinets and 45 calling keys in all besides the telephone sets; and thirty-five way station equipments consisting of No. 102-B selector sets, containing standard No. 50 type selector, and the new "folding gate" type telephone bracket, known as the No. 147, equipped with Western Electric desk stands. Foot switches, vacuum and cut-out arresters, and switch panels are also being furnished. Trains will be equipped with No. 1330-E portable telephone sets for use in communicating with headquarters from points between way stations. Each portable set will be furnished with line poles and plugs. The latter are to be used in connection with fifty No. 186 type jacks which will be installed at sidings along the right-of-way.

TRADE NOTES.

The Washington Iron Works, Seattle, are installing a three-ton Girod electric furnace in their new foundry, together with complete steel foundry equipment for the manufacture of high grade steel castings. This will be the first electric steel casting plant on the Pacific Coast.

W. N. Matthews & Bro. of St. Louis, announce that they have accepted the resignation of Benjamin C. Chase as their representative in Los Angeles and have turned this territory over to Lewis E. Sperry, who represents them in San Francisco. This now gives Mr. Sperry the entire State of California as a representative of this well known firm.

The Greenwood Advertising Company of Los Angeles have received a large order for electrical advertising from the Puget Sound Traction, Light & Power Company of Seattle, Wash. The order is for a sign 200 ft. long by 60 ft. high, which is to be installed on their power plant. This display represents a water fall and gives a most unique double reading effect. This company has just built a branch factory at Los Angeles to manufacture electric signs under the patents of the Greenwood Manufacturing Company of Knoxville, Tenn. J. E. Tucker is manager and C. P. Chamberlain, chief electrical engineer.

The Electric Storage Battery Company of Philadelphia, manufacturer of the "Exide" batteries for electric vehicles, gave a dinner on Wednesday evening, February 5th, at the Mid Day Club, Chicago, to 220 guests. These included the manufacturers of practically all of the leading makes of electric vehicles, their agents and the company's "Exide" distributors. Due to the unavoidable absence of Herbert Lloyd, president of the company, Charles Blizard, the third vice-president, presided, and the sales managers and department heads from the different offices of the company throughout the country acted as a reception committee upon the arrival of the guests. After the dinner an attractive vaudeville program was presented which was greatly appreciated by those present.

NEWS NOTES

INCORPORATIONS.

SALEM, ORE.—North Pacific Gas & Electric Company; $1,000,000, by C. J. Franklin, F. L. Shull, H. E. Lounsbury, W. W. Seymour and F. C. Brewer.

RIVERSIDE, CAL.—The City Water Company of Banning has filed articles of incorporation with capital stock of $20,000. The directors are C. D. Hamilton, Paul M. Davis, R. H. Coombs and Burton F. Southernland.

SPOKANE, WASH.—Articles of incorporation for the Des Chutes Power Company have been mailed to Olympia. The following are the officers of the company: Samuel Galland, president; W. C. Sivyer, vice-president; Burt L. Sivyer, secretary-treasurer, and L. M. Simpson, general manager. The new company is capitalized at $300,000. It is the purpose of the company to develop one or two water sites in that locality, one on Des Chutes River and one on the Crooked River.

ILLUMINATION.

ELMA, WASH.—The Elma Light & Power Company has been granted a franchise to construct, maintain and operate a system of works to furnish light, heat and power to the town of Elma.

LOS ANGELES, CAL.—The Southern California Gas Company has applied to the board of supervisors for two franchises. One covers the field west of Pomona and the other the entire northwestern part of the county.

ORTING, WASH.—J. L. Wadsworth of the Electrical Construction Company of Tacoma, accompanied by two electrical engineers, is going over the plans and estimates relative to the establishment of a municipal light and water plant here.

EL PASO, TEXAS.—The city council has adopted an ordinance transferring the franchise formerly held by H. C. Bosworth, to the El Paso Gas & Electric Company. The franchise gives the company the right to operate in El Paso for 30 years.

LOS ANGELES, CAL.—Bids will be received up to March 3d, by the board of supervisors, for installing the necessary equipment for lighting certain streets in the Lawndale lighting district, the system to be ready for service by June 1st.

MADERA, CAL.—The San Joaquin Light & Power Company is soon to start work on its power plant No. 4, to be located in Crane valley. The building of the power plant has just been decided upon and survey work will start about May or June. Two tunnels will be drilled to divert water from Sand Creek and South Fork to the plant.

LONG BEACH, CAL.—Two applications have been filed with the Railroad Commission by the Long Beach Consolidated Gas Company. One asked authority for the sale of a franchise held by George H. Bixby to the gas company and the other was for a certificate of public convenience and necessity for the corporation to operate under the franchise in Long Beach.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the Pacific Lighting corporation, held February 13, directors were re-elected as follows: C. O. G. Miller, Geo. H. Collins, Chas. Holbrook, A. Schilling and F. W. Van Sicklen. The directors re-elected officers as follows: C. O. G. Miller, president; Geo. H. Collins, vice-president, and Horace H. Miller, secretary and treasurer.

ROSEBURG, ORE.—A. Welch, owner of the Roseburg water and light systems, announces that $30,000 will be spent in Roseburg and vicinity this year. A new power unit, foundation for which was begun last year, will be completed and put in operation in May; work will begin on laying another 12 in. main from the Winchester station to this city; another wire will be laid between Winchester and Roseburg and larger water mains put in Kinney's addition. A contract has been secured for furnishing water and light to the city of Oakland.

CLOVERDALE CAL.—Fred L. Wright who is engaged in the promotion of telephone and electric light and power lines in this part of the State, was in Cloverdale last week inspecting the lines of the Cloverdale Light & Power Company. Mr. Wright's company, the California Light & Telephone Company, will shortly take over the Cloverdale company's franchise and equipment, together with a contract the local company holds with the Snow Mountain Company, which furnishes the current. The local lines will be extended to develop other territory.

TRANSMISSION.

NORTH YAKIMA, WASH.—The county commissioners have granted a franchise to the Pacific Power & Light Company for 50 years for a power line over the country roads near Naches and through that unincorporated town.

BAKERSFIELD CAL.—A franchise for an electric power transmission line has been sold to the Pacific Light & Power Corporation, also a franchise for a telephone line has been sold to the same company. A franchise for a power line has been sold to the Southern Sierra Company.

HOOD RIVER, ORE.—Engineers of the Pacific Power & Light Company under the supervision of P. L. Pierce, have established temporary offices here and are drawing plans for the proposed pipe line and power house of the power plant to be erected on the Hood River near the plant now owned by that company.

OLYMPIA, WASH.—Governor Lister and the special legislative committee which investigated the Celilo Rapids power project has recommended that Washington appropriate $15,000 to aid Oregon in an engineering investigation to determine whether the development of the proposition should be undertaken by the two States.

GLOBE, ARIZ.—Government surveyors are mapping out the route of a transmission line that will convey electric power from the Roosevelt dam to Superior. It will tap the line now being built to Miami at a point near that town. Installation of electric power will act as an impetus to development in this district as the present cost of power is almost prohibitive.

GRANTS PASS, ORE.—The Rogue River Public Service Corporation, newly organized to take over the property of the Chicago-Rogue River Company, bankrupt, the Oregon Water & Power Company and the Golden Drift Mining Company, are planning to build two more power plants and to construct 50 miles of irrigation ditches as soon as the reorganization is effected. Geo. E. Sanders is president, George W. Soranson, secretary, and Robert E. Gaut, consulting engineer.

OLYMPIA, WASH.—The Senate committee on irrigation and arid lands has voted in favor of a drastic bill aimed to oust the Northwestern Electric Company from the White Salmon and Klickitat rivers, where power for Portland is to be generated. The bill, if enacted into law, will prohibit the use of water within this State in generating power to be sold outside the State except by companies which are ac-

tually supplying such interstate power on or before March 1st of this year. Advocates of the bill say the power plant would do no good to the State because the power is to be sent into Oregon. They declare the water which is to be used for generating the power could be used to reclaim between 300,000 and 500,000 acres in the Horse Heaven country at a cost of only about $60 an acre.

SPOKANE, WASH.—Construction of an electric power line by the Washington Water Power Company between Spokane, Chowolah and Republic will be the big work for 1913, as outlined at the annual meeting held in Spokane, at which W. A. White, B. F. Lorenz, Frank Lyman, T. S. Hicks, H. T. White, Phillip Cabot and F. S. Bangs were elected as finance committee and D. L. Huntington, Dr. Fred Essig, W. S. McCrea, W. J. C. Wakefield, L. H. Davenport, I. P. M. Richards and H. H. Richards, executive committee.

SPOKANE, WASH.—It is reported here that the Chicago, Milwaukee & St. Paul Railway plans to purchase the Washington Water Power Company, using the four power plants of the latter to furnish power for the electrification of the Milwaukee main line between Avery, Idaho, and the Columbia River and for the development of an extensive system of interurban feeders radiating from Spokane. This is the project which is being worked out in connection with the electrification of the main line between Harlowtown, Mont., and the coast. The plan contemplates the consolidation of the city lines of the Washington Water Power Company and the Spokane Traction Company, to be taken over by a holding company, and a distinct and separate corporation which will be friendly to both the Rockefeller and Hill lines. The interurban system of the Spokane & Inland will remain with the Hills.

TRANSPORTATION.

SEATTLE, WASH.—The Seattle Car Company has been awarded the contract for supplying 65 cars for the British Columbia Electric Company.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will electrify the Mt. Hood line, 23 miles in length, which connects with the city car lines at Montavilla and extends to Bull Run.

TACOMA, WASH.—The city council has voted to build a municipal car line from Eleventh and A streets, over the new Eleventh street bridge and the tide flats to the city limits at Sitkum avenue north.

PORTLAND, ORE.—The Portland, Eugene & Eastern road will erect a mammoth station and office building on Fourth street at a cost of $1,500,000, to be jointly occupied by it and the S. P. Company, according to well-founded report.

OAKLAND, CAL.—To solve the difficulty which has arisen with the refusal of the San Francisco-Oakland Terminal railways to extend the tracks from Fourteenth and Washington streets, through to San Pablo avenue in Fourteenth street, Mayor Mott has asked Chas. A. Beardsley, assistant city attorney, to report to the council upon the feasibility of the city building the block of carline and then leasing it to the company.

SAN FRANCISCO, CAL.—At the joint meeting of the supervisors' public utilities committee and the exposition transportation committee the following action was decided upon: The supervisors will be asked to call upon the city engineer to prepare plans for a complete system of municipal street car lines not only to handle the exposition traffic but to provide for the transportation needs of the outlying districts of the city. This plan will include the Van Ness avenue line, the Stockton street line, with the Stockton street tunnel and the Columbus avenue extensions to Bay street; the extensions of the Union street line and the Embarcadero line. The Harbor Commissioners, through President Dwyer, promised to build the Embarcadero railroad, construct the Ft. Mason tunnel and arrange, independently of city and private corporations, a waterfront express train service between the Ferry building and the exposition grounds.

SAN FRANCISCO, CAL.—Testimony in behalf of the application of the Northern Electric to take over the Vallejo and Northern was given before Railroad Commissioner Edgerton. T. T. C. Gregory, president of the Vallejo and Northern, testified that the Northern Electric planned to pay $1,000,000 of its bonds and $2,000,000 of its preferred stock for the Vallejo and Northern. The deal involves the transfer by the Vallejo and Northern of holdings in the counties of Sacramento, Yolo, Napa and Solano, including rights of way, constructed track and extensive terminal properties. By this move the Northern Electric, which taps the heart of the Sacramento Valley, will have direct communication with San Francisco. The company's electric lines will extend from Chico, Marysville, Oroville and Sacramento to Vallejo and from there communication will be had with San Francisco by means of fast bay steamers. The merging of the two lines was negotiated by the Northern California Securities Company, recently organized, of which Chapman De Wolfe is the active manager. The directors of the securities company, which is also financing the Sacramento and Woodland road, the Colusa Terminal Company and the Marysville and Colusa branch of the Northern Electric, are: E. J. de Sabla Jr., Louis Sloss, E. R. Lilienthal, John Barneson, L. W. Griffin, W. P. Hammon and B. P. Lilienthal.

The amended articles of incorporation of the Northern Electric Company show a capitalization of $25,000,000, divided into 250,000 shares.

TELEPHONE AND TELEGRAPH.

YUMA, ARIZ.—The Mountain States Telephone & Telegraph Company will erect at once a modern building in this city at an estimated cost of about $48,000.

COLVILLE, WASH.—The Arden Telephone Company has petitioned the county commissioners for a telphone franchise. If granted, work of constructing lines throughout Stevens county will be started at once.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Feb. 7.

The Railroad Commission issued an order granting the Southern Counties Gas Company permission to issue bonds to the amount of $10,000.

An order was issued granting the Southern Sierras Power Company permission to raise its schedule of rates for electric power service for pumping for irrigation purposes in certain portions of Riverside and San Bernardino counties, outside of incorporated cities and towns.

An order was issued approving the deed of trust executed by the West Coast Gas Company to the Mercantile Trust Company of San Francisco, under which the former company may issue $100,000 of bonds. The proceeds will be used to pay off indebtedness and to make extensions.

Feb. 12.

Upon request of the applicant, the Commission dismissed the application of the Little Rock Power & Water Company for authority to issue bonds.

The Pacific Telephone & Telegraph Company was given authority to purchase the San Gabriel Valley Home Telephone Company.

A decision was rendered authorizing the Half Moon Bay Light & Power Company to accept promissory notes in payment for part of its capital stock, on condition that the stock should not be issued until the notes had been paid.

ALPHABETICAL INDEX TO ADVERTISERS

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Manhattan Elec. Supply Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.
Manhattan Elec. Supply Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Manhattan Elec. Supply Co.
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
Geo.E.DowPumpingEngineCo.
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Cord, Flexible Bell
General Electric Company
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Pierson, Roeding & Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Pierson, Roeding & Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Dow Pump'g Engine Co., Geo.E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.

Economy Electric Co.
San Francisco, 444 Market

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 726 Mission
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Tungsten, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pierson, Roeding & Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.
Manhattan Elec. Supply Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
Fairbanks, Morse & Co.
General Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Pittsburg Piping & Equip. Co

Plugs, Flush
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks, Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo.
(Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Push Buttons
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
Pierson, Roeding & Company
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco,357-361Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Manhattan Elec. Supply Co.
San Francisco, 403 Atlas Bldg., 604 Mission St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Moloney Electric Co.
San Francisco, Rialto Bldg.

Nason & Co., R. N.
San Francisco,151 PotreroAve.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 307-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 523 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 703 Spaulding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco,MonadnockBldg

Post Co., The Frederick
San Francisco, 135 Second

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
LosAngeles, Union Trust Bldg.

Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill,"Pierson, Roeding & Co.
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.
Switches, Push Button
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Tubes and Bushings
Ohio Brass Company
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Moloney Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Holabird-Reynolds Co.
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee,"Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Pierson, Roeding & Company
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co.,The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles. 1758W.Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 PacificBlg.
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco,682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

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TACOMA MUNICIPAL POWER PLANT

BY LLEWELLYN EVANS

MATERIALS ADVERTISED IN THIS ISSUE

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POWER AND GAS
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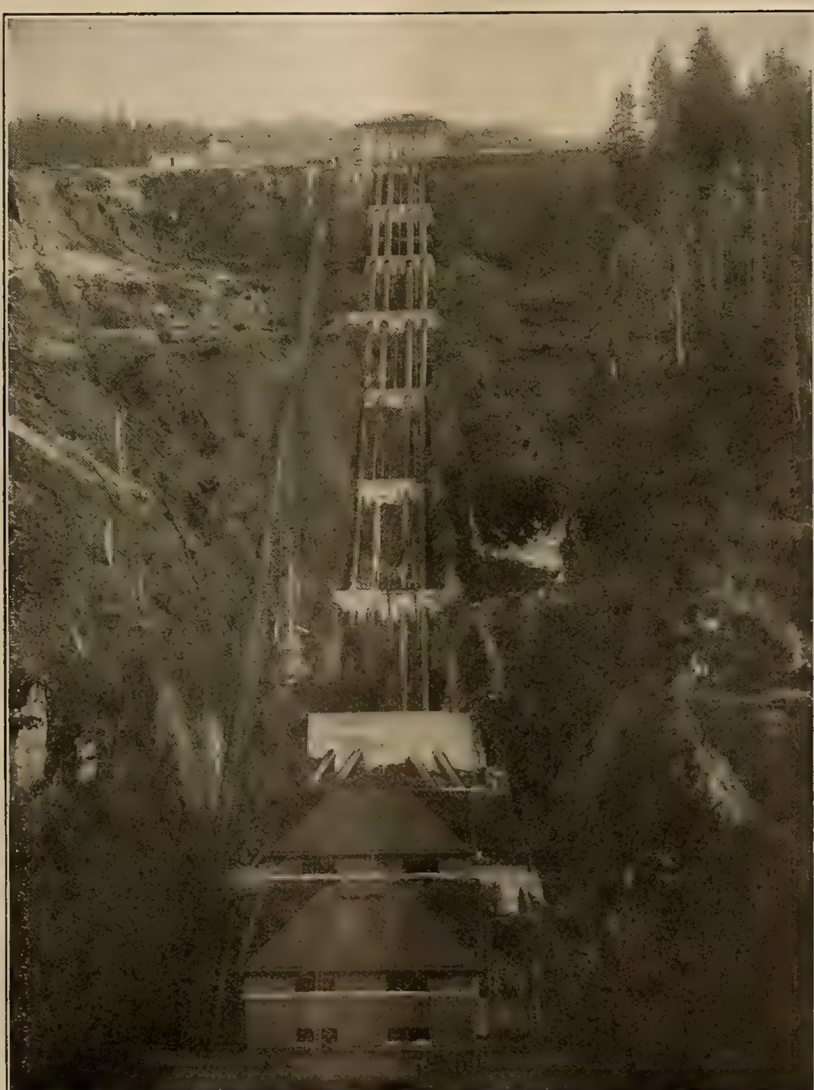
VOLUME XXX | SAN FRANCISCO, MARCH 1, 1913 | NUMBER 9

TACOMA MUNICIPAL POWER PLANT

BY LLEWELLYN EVANS.

The City of Tacoma has just completed and put into operation on November 15th a new power plant. A birds-eye view of this development and surroundings, looking from the south to the north, would show in the east foreground Mount Tacoma with the Nisqually River flowing from under its glacier in a northwestern direction; in the middle foreground, as the stream enters a steep-sided canyon and makes a bend, a low dam, gate and keepers' houses of stone and brick with a part of the stream diverting into the mouth of a tunnel entering the rocky bluff; in the middle of the picture this tunnel bursting through the sheer walls of the canyon at the end of the bend and a pipe line continuing its course on a steel bridge across the canyon, burrowing through the soil a short space and emptying its contents into a rectangular reservoir with gate houses perched on its walls, thence five steel pressure pipes leading down into the bottom of the canyon to a brick and concrete power house, issuing from behind which are six aluminum wires tracing with bright lines a path through the firs for ten miles to the northwest and thence twenty miles north across a level prairie beside a country road, to be lost in the background in the checkerboard of the city of Tacoma.



Penstock Pipes at the Power House.

For the purpose of letting contracts the complete project was divided into sections, the first of which included the erection of the intake dam, gate houses, gates, settling channel and the 11,000 ft. tunnel through solid rock.

Dam and Headworks.

The dam is built of reinforced concrete and spans the river between solid rocks. A passageway is left inside in lieu of a bridge. This is necessary because the railroad is on the opposite side of the river from the intake. Light and air are admitted to the passage way through openings left on the down stream side. The length of the dam is 260 ft. and the height 40 ft.

For the purpose of cleaning out the sand double gates, operated with motors protected with suitable housing, are provided. These gates are 8 ft. square and are made of steel and slide in close fitting guides. Two screws, driven by one 50 horsepower motor, raise the gates. The main gates admitting the water through a 1000 ft. settling channel into the tunnel are of similar construction.

All of the buildings about the headworks, including the gate keeper's house and the gate houses, are built with stone as high as the windows and have clinker brick walls and green tile roofs.

Tunnel.

The tunnel, practically 11,000 ft. long, is straight from end to end and cut through the solid rock with a width of 8 ft. 6 in. and a ceiling height of 10 ft. 6 in. The sides and floor have been lined throughout with concrete and the ceiling has been left of rock except at places where the ground is loose. The fall in the tunnel is just sufficient to maintain the flow.

Cutting through the rock occupied about two years and during the best part of the progress 9 ft. per day was cut out from each working face. The muck was removed by electric trams. Very little water was encountered until about half way through, and then not sufficient to delay the work greatly. The rock removed was suitable, after being crushed, for concrete footings and floors, but was not the best for the reinforced concrete work.

At the north end of the tunnel the canyon is 373 ft. deep, and has practically vertical walls. The tunnel is continued across this canyon by means of a steel cantilever bridge. This bridge has a span of 200 ft. and carries a 10 ft. diameter steel pressure pipe, connected through a concrete section to the tunnel. The pipe line is 400 ft. long and is provided with three expansion joints and has manholes at both ends. A walkway with rail is built on both sides of the pipe line.

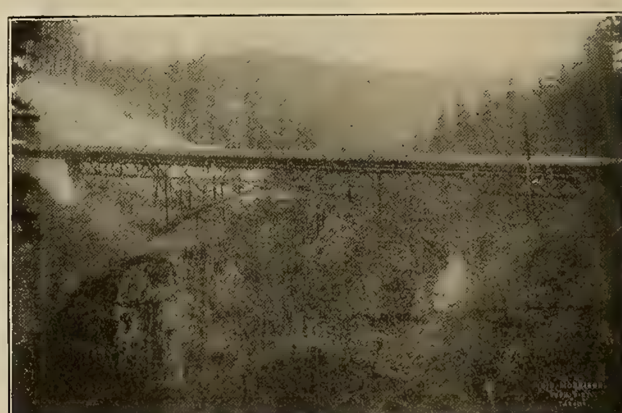
Reservoir.

From the pipe line on the bridge the water flows into an underground reinforced concrete conduit 8 ft. 6 in. by 10 ft. for one thousand feet into an open reservoir 560 by 500 ft. with reinforced concrete walls 22 ft. high and cement floor. The water is admitted to the reservoir over a spill-wall 400 ft. long. In case of too much water two waste gates 6 ft. by 6 ft. are provided, which allow the water to flow on past the reservoir and down over the canyon walls through a flume. At the waste and by-pass gate house are located gates admitting water to two conduits 4 ft. by 4 ft. 6 in. under the reservoir to the forebay gate house, providing a source of supply for the generators while the reservoir is being washed out. The wash out gates are provided on the low side of the reservoir, through which the sand and mud may be flushed, partly by water flowing over the spillway wall and by water from a hose connected with hydrants located around the reservoir. The forebay gate house is the largest of the gate houses shown in the picture. During the wash out process muddy water is prevented from entering the pipes by a weir wall about 3 ft. high, separating the reservoir and the entrance to the penstocks, and likewise this prevents water through the by-pass conduits returning to the reservoir. The gates are lifted with double screws operated by a single 40 horsepower, slip ring, induction motor set vertically. Current is supplied to all the gate houses by a 6600 volt transmission line from the power house. Transformers with protection devices are placed in the waste and by-pass gate house. All the gate motors are operated with hand controllers except those at the forebay which close the penstocks. These have remote control panels so that these gate motors can be started either from the power house switchboard or the gate houses. The reservoir has a capacity of 3,020,000 cu. ft. The walls are built in sections, dove-tailed together and calked. The floor is also laid in sections, the edges of which rest on a checkerboard of concrete beams. The floor is calked with oakum and tar at the seams.

La Grande Washington, showing the reservoir, Tacoma Eastern Railway in the foreground; By-Pass Gate House at the right; Wash Out Gate House near the center and Fore Bay Gate House at the center. From the Fore Bay Gate House the water is carried in steel penstocks to the Power House 425 ft. below. The canyon walls can just be seen beyond the Fore Bay Gate House.

Pressure Pipes.

There are four large pressure pipes, one for each unit, tapering from 72 in. in diameter at the top to 61 in. at the power house. Also an exciter pipe line with a lower diameter of 24 in. The pipe line pitches down the hill on a 62 per cent grade and the pipes are supported at 8 points by concrete piers for anchors. Footings on solid rock were obtained on the lower four piers. The upper piers rest on hard-pan or blue clay. The flanges on the pipes anchor them to the piers except on the upper half where a clearance has been left to allow the pier to slip without carrying away the pipe in case the footings prove



Pipe Line Crossing Canyon on Suspension Support.

shifty. At the intake of these penstocks a 12 in. by-pass pipe is provided with two inlet valves and an opening into each penstock, and the exciter line.

Excavating for the erection of these pressure pipe lines was the most troublesome part of the construction, inasmuch as the power house was being built at the same time and had to be protected from rolling rocks and from blasts. The larger part of the dirt was taken out by water and much of the rock removed by the blasts and transported by gravity cars. The power house was protected by leaving a thin wall of rock next to the same until the last, and removing all dirt above it through a tunnel.

Power House.

The power house is constructed with a concrete foundation, reinforced concrete floors, clinker brick walls, steel roof trusses, plank and tin roof, all designed in architectural harmony. The generating floor is about 24 ft. above the normal flow of the river. The building might be described as a series

View of the generator room from the crane basket showing two of the four units and the exciters, switchboard gallery at the right with telephone booth and report desk at the end.

of houses built in place one behind the other, first the generating building, second the transformer building and third the high tension wiring and switching building. Below the generator room floor is a basement allowing access to the butterfly valves in the penstocks and wiring for the generators. The tail race, 15 ft. wide and 13 ft. high, passes under the middle of this basement. The generator room is provided with a 35-ton alternating current crane. Three of the walls have as many windows as can be accommodated. The 40-foot ceiling makes a very light room for the machinery.

The switchboard gallery on the up-hill side half way up commands the entire floor space. The transformer house is similarly constructed, with a 10-ton crane, similar high ceilings, but less floor space, the building being narrowed down behind the generator room to admit of the pressure pipes passing on each side. The high tension building has a 35 ft. ceiling and floor space 70 x 44.

Equipment of Power House.

The penstocks connect to the spiral casing of 8000 horsepower, single discharge, Francis, inward flow, reaction type, Allis-Chalmers turbines on horizontal shaft, direct connected to 5000 kw., 6600 volt, 3-phase, 60 cycles, 450 r.p.m. generators made by the same company. Four such units are in place. The exciter pressure lines are connected to two 125 volt exciter units driven by Pelton water wheels. Each turbine is equipped with 48 in. motor-driven butterfly valve, pressure regulator with release valve, oil pressure governor, auxiliary hand control and tachometers. The single discharge feature of these wheels save 25 per cent of the floor space originally provided in the plant and allowed a corresponding reduction in the size of the power house. All generating equipment is connected with the low tension bus with lead encased, varnished cambric insulated cables. The exciter bus is located in the basement and the alternating current low tension bus behind the generator room in the basement of the transformer building. Each generator is connected through a non-automatic solenoid operated oil switch.

The station is designed so that two units may be operated separately from the other two or may be tied together by a tie switch located between the generator switches.

The transformers, twelve in number, made up of four banks of three single-phase transformers, are fed from the main bus with disconnecting switches and remote control oil switches. The wires from the high tension side of the transformers pass through special wall bushings through the 60,000 volt oil switches to the high tension bus which is divided into two halves by a tie switch. The two out-going lines can be supplied from any generator through any bank of transformers, or any two generators can be connected with either pair of banks of transformers and their current delivered to either line.

The switchboard is divided by a central column into two sections containing two generator panels, two transformer panels and one line panel each. All switches are remote controlled with drum switches on this board. A constant voltage is maintained by a Tirrel regulator provided with two groups of ten relay contacts for each exciter. Each generator panel is provided with a graphic wattmeter, integrating power factor meter and three ammeters. But one voltmeter is provided for all generators. Plugs on each generator panel connect to the synchroscope and voltmeter.

In addition to the graphic wattmeters on the generator panels there is provided a graphic frequency meter, two power factor meters and voltmeter. Each transformer panel is provided with three ammeters and each line panel with three ammeters and an integrating wattmeter. All this equipment is mounted on beveled blue Vermont marble slabs and the entire board is lighted with special Frink reflectors with ground glass diffusers. In addition to the

drum switch controllers for oil switches there are also provided controllers for the butterfly gate motors and governor motors. The complete remote control provided makes it possible to operate the station with one oiler and a switchboard operator.

Four banks of three transformers each, with a total of 5000 kw. capacity, are connected in star both primary and secondary, and are protected from discharge during switching and shorts or trouble by lightning arresters located between the banks. These are connected from the low tension side and are of the aluminum cell type. The transformers are cooled with water from the pressure pipes.

Lightning "catchers" are provided for each line. The cut shows four tanks and transfer switch at the right. The tanks contain a stack of aluminum trays filled with a caustic electrolyte immersed in oil. The cells are charged two in series by swinging the horns close together with the transfer switch, which is grounded first right and then left, a ripping arc occurring at the horns.

The oil system consists of two tanks for transformer oil and two for switch oil, with rotary pumps for filling the tanks. A vacuum pump is provided with connections to the top of the transformer to maintain a slight vacuum to carry off the moisture. The transformers set in the large, airy room above described are surrounded with a rim of concrete about 6 in. high to keep any oil or water from getting out into the room. The space is drained to the river.

In the high tension room is provided a three-pole oil switch for each transformer bank, for each high tension line and for a tie between lines. Disconnecting switches are provided for the oil switches and arresters.

Transmission Line.

Cedar poles, many of which were cut on the right of way, are used throughout. For about the first ten miles there is a double transmission line of three wires arranged on a triangle with six foot spacing, but for the remainder of the way, due to right of way arrangements, it was necessary to carry both lines on the same pole, the arrangement being to support the same on the ends of three crossarms with six foot centers. With the 45 ft. poles used there would ordinarily be small clearance, but the ground traversed is level prairie. Upright insulators on cast iron pins are bolted to the crossarms with four ⅜ bolts. Stranded aluminum cable, equivalent to No. 2/0 copper wire, is tied to the insulators with No. 6 solid aluminum ties. There is one specially long span across the Mashel River, where "A" structures, mounting a multiple row of standard insulators, carry copper cables.

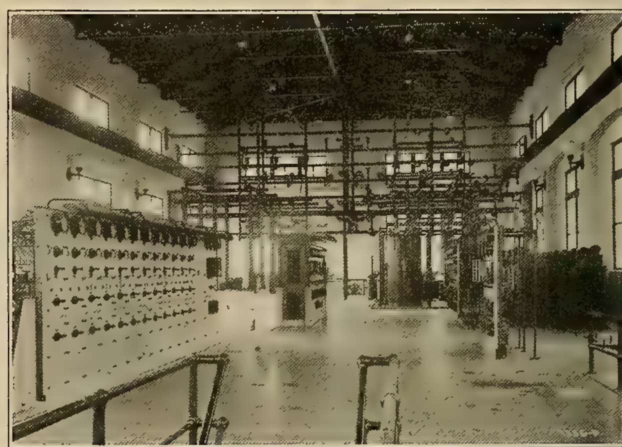
Substation.

At the substation in Tacoma, shown in the cut, the high tension equipment at the power house is duplicated. Only two banks of transformers are now in place. The control switchboard is provided with drum switches for controlling each transformer switch and each line switch. Graphic meters record voltage, power, frequency and power factor.

The main bus wall is made of pressed brick with reinforced concrete shelving and supports a duplicate bus which at the heaviest part is made up of six 4 in. by ¼ in. laminated copper busses.

Taps are taken off through fibre bushings to disconnecting switches on the opposite side of the wall. The compartments containing the taps and disconnecting switches are shown at the left of the picture showing the lighting switches. The low tension pressure in the station is 4000 volts between busses and 2300 to ground. A three-phase, four-wire distributing system is used throughout the city.

The interior view of the substation shows the arc lighting panels on the left, the main control board in the center, power distributing panels at the right and lighting distributing panels in front of the regulators. The special features connected with the arc lighting panels are the cement barriers and supports, one of which is shown in the picture.



Interior of substation; Arc Board at the right; Main Control Board center; Light and Power Panels right; Transformers and High Tension Wiring rear.

The wires leading from the oil switches on these panels are carried to the floor below in fibre ducts cast in these barriers. On the ceiling under the switchboard the wires are carried in one-inch fibre conduit with appropriate fittings, and follow down some brick columns and along brick walls to the arc tubs on the floor below. These wiring features were all worked out in detail in the engineers' drawings and were executed to make a very neat appearing job. Provisions the made for 50 arc circuits and spare room left for as many more.

The lighting panels, five in number, control one 4-wire circuit each. Drum controllers operate each pole of the oil switches separately. On each feeder single-phase current regulators controlled by primary and secondary relays maintain constant voltage at any pre-determined point in the line. Each panel of the lighting switchboard mounts three ammeters, three voltmeters, three primary and secondary regulating relays, integrating wattmeter, graphic recording wattmeter, two overload relays, and four drum controller switches with their indicating lamps. The wiring for these various instruments and equipments is mounted on cleats, in places, seven wires wide and three deep. Connecting up these panels, together with the regulators and remote controlled switches cost about $150 per panel for labor, but elegant results were obtained.

Power circuits are provided with a similar switchboard except that the regulators are omitted. Control current for all the solenoid operated switches and indicating lamps is furnished by a 135 volt storage battery with a 5 kw. charging set.

The most noticeable feature of this station to the visitor is its wide stairway, white tile wainscotes, high ceilings and generous lighting. The station is unusually roomy. All cables leaving the station go out underground through tunnels under the basement floor. At the present time these underground circuits are carried from the manholes in the street nearby up to overhead wood pole lines.

Cost of Construction.

All of the above described project has been completed, including the cost of rights and legal arrangements and the cost of selling the bonds, for practically $2,500,000. The station has a capacity in the size of tunnel, reservoir, pipe lines, generating equipment, transmission line, and substation for a normal load of 20,000 kw. This would make an overall cost per kw. of equipment, including the substation, of $125. By omitting the costs of rights and substation a much lower cost per kw. could be figured out for comparing with similar projects.

The main secret of such low cost of construction is due to the fact that all the work was done by contract, and in all there were not less than fifteen contractors and sub-contractors, each doing his own specialty in the construction of the various parts of the plant. Large credit may be also given to the fact that the plans were gotten out complete with details to the last hexagonal nut of every part of the work before contracts were let. The contract for the tunnel having been let first, the engineers had practically two years for the completion of accurately detailed plans for the remainder. There might also be some credit due to the fact that there were three different project engineers connected with the work:

Frank C. Kelsey started the work and laid down the broad lines on which the project was based. During his time the hydraulic features of the headworks and tunnel were completed and the remainder of the work well outlined. He was criticized some for his extravagance in design, so that when his successor, Hamilton F. Gronen, took charge of the work there was opportunity for econimies before the balance of the contracts were let. These were effected, not so much at the expense of permanency, as with the selection of standard apparatus and new designs in place of special designs. The work was completed by Herman Keith, who has a reputation as a construction engineer.

The Tacoma Eastern Railroad passes with the reservoir power house and the head works, and was a large factor in making a low cost of construction.

It may be said that the personal interest of each city official engineer, contractor and workman added to the success of the project and accounts in a large measure for the excellent work and low cost. The usual municipal project has a similar history in the matter of changes in organization but not many seem to have worked to the good of the public, instead of to its detriment.

It is hoped by the well-wishers of the municipal plant in Tacoma that the theoretically certain failure, due to lack of continuity of purpose, will not befall this plant, as it has many other municipal undertakings. The city maintains and owns its own distributing system for light and power and has by ordinance a monopoly on the electric lighting business of the city. It has, however, competition in the matter of power. The rates for lighting range from a 6c to a 3c minimum on a sliding scale according to quantity used in a month. Power rates vary from 2.4c maximum to .72c minimum on a sliding scale according to the customer's load factor. While the city cannot sell as much power current as her competitors she will at least govern the maximum cost for some time to come.

Summing up the situation, the city has purchased for a low cost per kilowatt a power plant having permanent concrete dam and headworks equipment, a conductor for water cut through the solid rock which will not deteriorate, a concrete reservoir, heavy short steel penstocks, the newest and most approved and tried machinery installed in permanent fireproof buildings and the transmission line on a wide right of way with a few danger points. It is estimated that this installation can be operated at a minimum cost for labor and practically negligible up-keep. With this it is hoped that the citizens of Tacoma have protected themselves against high power rates and have established an enticement for manufactories.

The responsibility of first putting the electrical equipment into service, and adjusting the troubles that are sure to appear at that time, was taken care of by Tacoma engineers, Evans-Dickson Company, who were sub-contractors on erection of the detail electrical equipment. The writer had the pleasure of personally supervising the work, and hopes to later write an account of these starting up experiences.

STREET-LIGHTING METHODS IN ARABIA.

BY CONSUL WALTER H. SCHULZ, ADEN.

The streets and buildings of Aden and all important towns of this consular district are lighted by means of kerosene lamps, the only exception being three private electric plants at Aden maintained by the Peninsular & Oriental Steam Navigation Company, the Eastern Telegraph Company and the Residency (the governor's residence), and a few gasoline burners used in some of the larger stores. The local authorities on several occasions have inquired into the feasibility of providing more modern lighting methods, but obstacles have always been encountered.

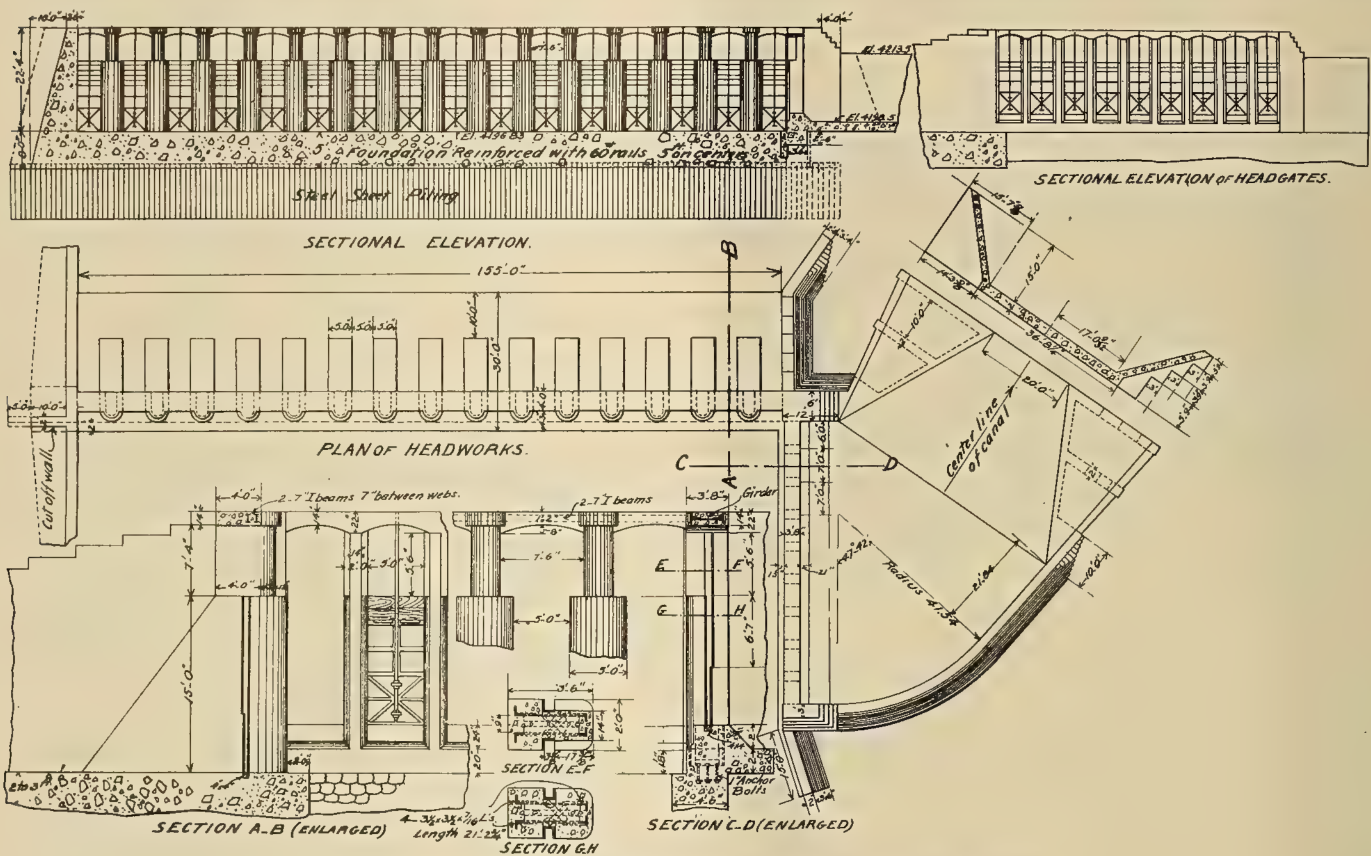
Keresone being the universal illuminant in this part of the world, there are a large number of oil lamps competing in this market, among which the German, English and Austrian articles predominate. Successful American competition, therefor, is a matter of doubt. Of course only Europeans and natives of the better classes are in a position to buy lamps. The native of the coolie type is content with a tin container of a gill capacity and which, together with a slender wick, costs him about 1 cent. It yields a dim and flickering light, but answers fully the needs of his humble home.

ELECTRICAL PUMPING AND IRRIGATION

DETAILS OF HEADGATES.

BY B. A. ETCHEVERRY,

The make-up and detailed design of the regulator at the head of a main canal may be illustrated by two very different types of diversion works: the headworks of the Truckee Carson project on the Truckee River and the headworks of the Yakima Sunnyside project on the Yakima River. These works are shown in the accompanying plans supplemented with a general description and cost data.



Diversion Dam and Headgates—Truckee-Carson Project, Nevada.

Headworks of Truckee-Carson project.

The headworks of the Truckee-Carson project on the Truckee River consist of an open diversion weir and canal headgate or regulator at right angles to the diversion weir, built in one structure. The diversion weir is 155 ft. long and consists of 15 piers placed 10 ft. on centers; between the piers and abutments are 16 gates. The piers rest on a concrete foundation 8 ft. thick and 30 ft. wide reinforced with 60 lb. rails, spaced 5 ft. on centers in both directions. Sheet steel piling 12 ft. long was driven 2 ft. from the upstream face of the foundation floor for a distance of 185 ft. These piles extend well in the bed of the stream which is composed of gravel, boulders and sand. Beyond the concrete foundation a paving of large stones extends 30 ft. down stream; the thickness of the paving is 5 ft. at the upper end and 2 ft. at the lower end. The piers are walls 15 ft. high, 6 ft. 3 in. wide at the top and 18 ft. wide at the bottom; the thickness is 5 ft. These walls are not reinforced and are designed as gravity walls. On top of these piers are smaller piers on which rest the operating platform. The operating platform is arched and reinforced with I beams well anchored to the piers to resist the upward pressure when forcing the gates closed.

The gates consist of cast iron gates each 5 ft. high and a set of flashboards for the upper 5 ft. When the lower gate is raised 4¾ ft. it catches the second cast iron gate and both are raised together. The flashboards are 3 in. x 12 ft. x 5 ft. 8½ in. The total height of opening can be 15 ft. The advantage of having the gate in sections is that it does not require a lifting force to raise them as large as if they were in one piece. To reduce friction all bearing surfaces are machine faced. The lifting stand is of cast iron with bevel-gearing operated by a hand screw. The headgates consist of 9 gates 5 ft. wide. The posts between gates are 7 ft. center to center and 2 ft. thick. For sluicing the silt and sand past the headgates, the sill of the headgates is made 3 2/3 ft. above the floor of the weir. The concrete floor has an average thickness of 2 ft. The floor at the sill is 6 ft. thick with a cut off wall in front extending down into the stream bed.

The headgates differ from the weir in that instead of piers of plain concrete the posts are made of concrete reinforced with built-up steel girders which allow of much lighter construction. The posts are de-

signed as beams. About two-thirds of the water pressure is transmitted to the floor and about one-third to the operating platform, which is also reinforced with a built up steel girder to resist this pressure. The gates are similar to those of the weir except that there are only two flashboards instead of five, and the total height of the gates is 11 ft. 4 in.

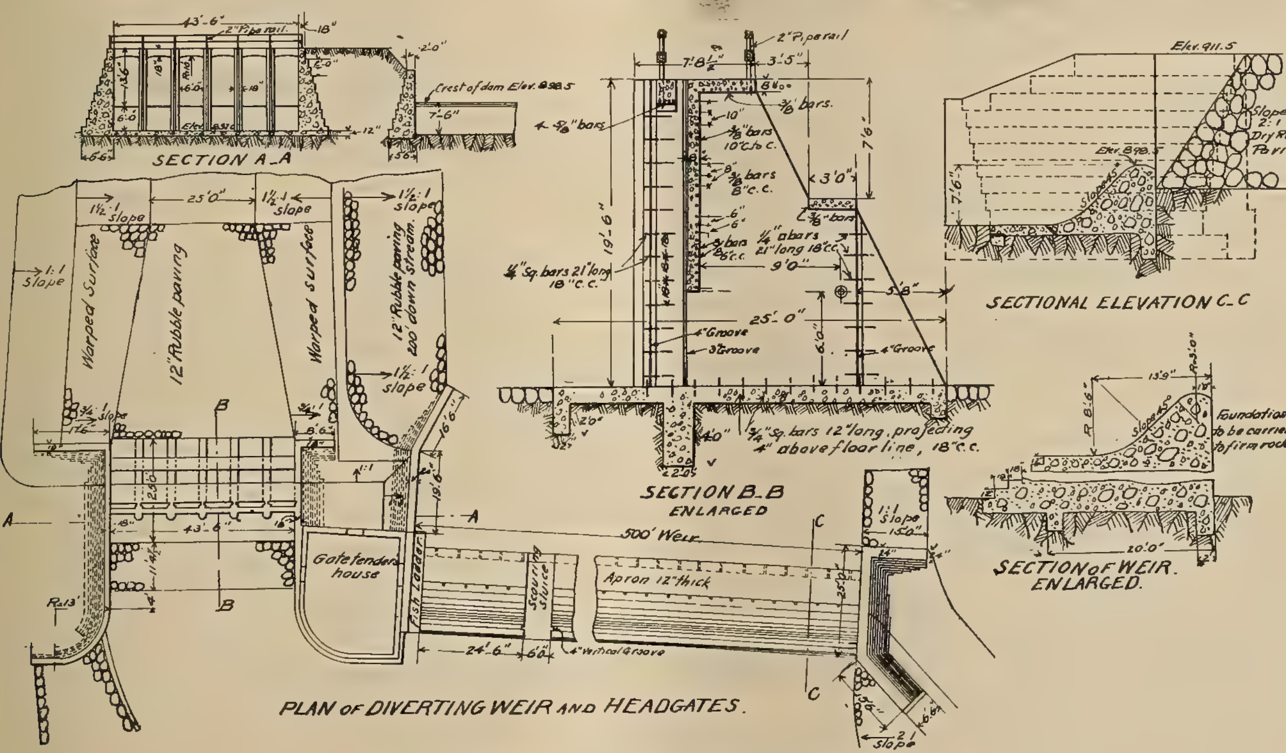
Beyond the headgate is an overflow spillway with its crest 13 ft. above the bottom of the canal intended for close control of the water if too much water is admitted to the canal.

The total cost of these headworks was $85,390 distributed about as follows:

Cement, 3971 barrels at $2.95	$10,126
Excavation	13,397
Concrete, 3322 cubic yards	19,932
Sheet piling	5,365
Gates, guides, stands, etc.	12,129
Riprap	13,548
Temporary flume	2,373
Steel girders, lumber, puddling	8,520
	$85,390

tinued beyond the 20 ft. with a series of steps 1 foot 6 in. wide and 1 ft. high. Cut off walls 2 ft. wide extend 1 ft. into solid rock at the upstream toe of the weir and at the lower end of the apron. The crest of the weir is 6½ ft. above the sill of the headgates, which assures that depth of water through the gates when the water just overflows over the weir.

The headgate is 43 ft. 6 in. wide and 19 ft. 6 in. high. The top of the operating platform is at the same height as the top of the earth embankment beyond the end of the diversion weir. The headgate consists of six gate openings 6 ft. high and 6 ft. wide, separated by buttress walls 18 in. thick. Between the buttress walls above the gate opening are panel walls 8¼ in. thick reinforced with ⅜ in. square bars. This panel wall takes the pressure of the water above the gate openings so that the pressure on the gate is much less than it would be if the entire space between the buttresses was open and had to be closed with



Headwork—Yakima-Sunnyside Project, Wash.

Headworks of Yakima-Sunnyside project, Washington.

The diversion weir is a closed weir of the Ogee type. The headgates are separated from the weir by the gate tender's house. About 25 ft. away from the gate tender's house is a scouring sluice 6 ft. wide, which for a stream carrying much silt would not be sufficient. It would also be preferable to have the scouring sluices nearer the headgates.

The weir is 500 ft. long and rests on rock. The cross-section of the weir is commonly known as the Ogee type and consists of a curved crest and a curved lower face continued with an apron 1 ft. thick. The width of the weir from the upstream face to the end of apron is 20 ft. The height of the crest above the apron is 7½ ft. The crest is curved with a 3 ft. radius while the lower curve as an 8½ ft. radius. In the deeper portions of the stream where the crest is more than 7½ ft. above the bed of the river, the apron is con-

gates extending to the top of the platform. The panel wall is also necessary to prevent water from overtopping the gate during flood flow.

The operating platform is 8 in. thick and is reinforced with ⅜ in. steel square bars placed 6 in. on center 1½ in. from bottom of slab. The gates are vertical cast iron gates with 3½ in. gate stems. They slide in metal grooves placed in the buttress wall and are lifted by cast iron stands with beveled gear operated by hand.

Below the cast iron gates is another set of wooden gates of the Taintor type, which are radial gates hinged 6 ft. above the floor and 9 ft. from the outside face of the panel wall. These gates are emergency gates to be used when it is necessary to close the gates rapidly, as they can be dropped very quickly. The emergency gates would very seldom be used.

The dam was built of rubble concrete composed

of large stones, which could be handled by one man, incorporated in the concrete. The proportion used was 43 per cent rubble stone and 57 per cent concrete. Eighteen hundred and nine cu. yds. of rubble concrete were put in the dam at an average cost of $6.40 per cu. yd. excluding engineering and administration. For the headgates, 493 yds. of concrete were put in for

Finished Appearance of Headworks—Truckee-Carson Project, Nevada.

the foundations and wings at an average cost of $13.95 and 38 yds. for the buttress walls, panel walls and platform at an average cost of $28.70, including reinforcement. The cast iron gates cost $2,529 in place. The concrete work for the headworks cost nearly $20,000. Excavation for abutments and dams, building of dyke, widening of river channel, excavating main canal, etc., brought up the total cost of the headworks to $48,531, including administration.

LETTER TO EDITOR ON LIGHTNING ARRESTERS.

Editor Journal of Electricity, Power and Gas:

I have read with interest the articles on lightning protection for transmission lines by Mr. Alfred Still which have recently appeared in the columns of the Journal. Referring to the article appearing in the Journal of Feb. 1, 1913, wish to ask if you know of any experiments having been made and if so what success was attained in the use of a section of iron pipe through which a single wire of a high tension transmission line was passed with the idea of using it in the place of a choke coil? It occurs to me that such an arrangement could be made which would offer a proper choking effect and yet not have sufficient inductance to impede the flow of the ordinary line current at the normal operating voltage and frequency. If this were practicable it would be a much simpler and much cheaper form of choking device than the ordinary choke coil for lines upon which a voltage of say 50,000 or 60,000 volts were carried.

I would thank you for any opinion which you may have on the subject.

Yours truly,

THE NEVADA-CALIFORNIA POWER CO.,

Geo. M. Wills, District Manager.

Reply.

Attempts to increase the flux of induction by providing choke coils with iron cores, or passing a single conductor through an iron tube in the manner you suggest, do not lead to satisfactory results when dealing with very high frequency currents. The effect of hysteresis, by causing the changes in the magnetic flux to lag behind the changes in the current, alters the phase relations between the current and the induced volts; and, for dealing with sudden impulses of energy, or high frequency oscillations, a coil with iron core (or the proposed equivalent) would not be so effective as a coil without iron core which, under normal conditions, would have the same inductance.

I do not know if practical experiments have been made with the arrangement you suggest; but on so high a voltage as 50,000 or 60,000, the current would be comparatively small, and, since the cost of the choke coil will be largely in the terminals and insulating supports, it is doubtful if any appreciable economy would be effected by departing from standard practice. ALFRED STILL.

Purdue University, LaFayette, Ind., Feb. 13, 1913.

TRANS-ISTHMIAN ELECTRIC TRANSMISSION LINE.

Survey began early in December for the location of towers to carry the electrical transmission line which will follow the relocated line of the Panama Railroad from Cristobal to Balboa, connecting terminal substations at those points. The line will be fed normally from the Gatun hydroelectric station, and will be tied into the permanent steam-generating station at Miraflores. Energy will be transmitted along this line at a potential of 44,000 volts, in delta connection, and reduced at centers of distribution to the requisite potentials for the operation of machinery and for lighting.

Each tower is to be a track-span bridge, consisting of two side frames connected by a cross-bridge all of skeleton steel construction. The bridge is to support duplicate three-phase lines, one on either side of the track, a ground wire strung from the top of each side frame, messengers and cables for duplicate telephone trunks and for track signal circuits, and the necessary messengers and wires for a catenary trolley construction should the Panama Railroad be electrified. Under the specifications being prepared, preliminary to advertising for bids on furnishing materials for the line, 725 single-track and 100 double-track bridges will be required, with 2,000,000 ft. of copper wire, No. 00, B. & S. gauge, 6500 three-unit suspension insulators, and 1000 ground plates. Inasmuch as the commission has secured poor deliveries upon recent requirements of structural steel fabrications, in connection with unfavorable prices on both steel and copper in the United States market, foreign manufacturers will be invited to compete for furnishing materials for the transmission line.

CONCRETE AT PANAMA.

Over 95 per cent of the total of 4,446,530 cubic yards of concrete to be placed in the locks had been laid at the close of work on January 18, the amount in place being 4,245,472 cubic yards. Over 94 per cent of the concrete for the system of three twin locks at Gatun has been laid, the amount in place at the close of work on January 18 being 1,929,306 cubic yards, out of a total of 2,043,730.

READINESS TO SERVE METHODS

COSTS OF ELECTRICALLY OPERATED FARM VEHICLES.

BY ROSS B. MATEER.

General consideration of the transportation problem does not limit the range to the "steel road" or tram car but includes within its scope, every application of mechanical power wherein a comparison is possible with the horse and his ability to perform work. In the city, the conveying of humanity or merchandise from one point to another is a problem presenting but two phases, the distance covered and the number of stops per unit distance traveled, while in the country the time element becomes a factor of prime importance, as the acreage cultivated increases. Formerly, the farmer trudged many miles patiently following his horse and plough, turning over an acre of soil each day. Today the gas tractor, requiring the attention of one man, accomplishes the same amount of work in thirty minutes. And where large acreage permits of the use of three tractors, hauling fifty ploughs, an acre can be turned over in 4¼ minutes.

Electrically Operated Portable Thresher.

Consider if you will, the cost per acre with the horse as $4, and with a gas tractor of only $1.60 per acre. The cost, per acre, ploughed, with the electrically operated plough, will, in the near future, be further reduced by reason of increased efficiency of prime mover and the rapidly decreasing cost of electric energy.

The necessity for the development of electric ploughing is evident when the turning over of five square miles means a distance traveled of 25,000 miles or a single furrow around the earth. Time element and cost per acre demand the solution of the problem of tilling the soil on an electrical basis and enroll it as a transportation problem of first importance.

The "Utility Truck."

Grass must be watered and it is not always convenient to install a number of pumping outfits, as certain portions of a given acreage may be flooded on successive days. The solution for this problem is a portable motor-operated pumping equipment, not mounted on skids but on its own truck, electrically propelled. The advantages of such an outfit are evident, suffice it to say, that the same motor used for pumping may be belted to the thresher and separate the grain from the chaff.

Threshing Grain.

Alfalfa when cut must be carried to the barn, or if baled on a requisition, delivered to the railway, often a considerable distance from the field and farms. Horse-drawn vehicles have been used and found unsatisfactory by reason of (a) maximum operating expense, (b) limited distance traveled, (c) limit to tonnage carried, (d) maintenance.

The four reasons above stated are those occurring frequently in an effort to obtain an idea of the transportation problem and its effect on the hauling of alfalfa, hay or grain from the field to markets, and indicates clearly, the large field for electric vehicles that are (a) prompt in action, (b) creditable in appearance and (c) suitable for the work required of them.

Where the time element in carrying grain to the thresher, by reason of variable weather conditions, is important, the electric vehicle is a valuable addition to the farm equipment. Again, with an electric truck, farms which are distant from the railroad, can be purchased at reasonable figures and made as valuable, if not more so, than those farm lands contiguous to the city. Such farms, once termed remote, are

Fig. 3. Electric Truck in Harvest Field.

no longer so as their proximity is measured not by miles, but by hours and ability to quickly deliver the crop at the nearest railway station or boat landing.

The same truck that is used for delivering produce or dairy products at the terminal points may be advantageously operated in the harvest field performing nearly the same amount of work accomplished by three two horse wagons.

A 3½ ton electric truck loaded with 617 bundles of grain yielded 45 bushels of wheat, while the maximum load in bundles on the regular wagon was only 260, demonstrating the superior carrying capacity of the electric vehicle.

Mountain or plain, gravel or sand, wet or dry roadways have no terrors for the electric truck which experience demonstrates travel a greater distance per unit cost of energy than those operated by horse or gasoline engine.

In the Scientific American, Mr. John Ritchie Jr., presents a report on the mileage obtained by vehicles at an expenditure of one ($1) dollar. The expense items are grouped under four heads: (1) electricity, gasoline or feed; (2) maintenance—tires or shoeing, repairs, battery, veterinary, lubricants; (3) garage or stable, driver or helper; (4) overhead charges, including depreciation, interest and insurance.

Motive Power.	Capacity of Truck.	Distance Traveled in miles.
Gasoline		3 1/2
Horse	1000 lbs.	3 7/8
Electric		4 2/5
Gasoline		2 3/5
Horse	4000 lbs.	2.9
Electric		3 1/4
Horse		2.07
Gasoline	7000 lbs.	2.3
Electric		2.7
Horse		1.6
Gasoline	70,000 lbs.	3 7/8
Electric		2.2

The above figures were compiled on fuels at the following rates: Horse feed, $190.00 per year per head; gasoline at 16c per gal, and electricity at 3c per kw.-hr.

The first two items are constantly increasing, which will result in decrease in mileage, while the charge for current and the downward trend in the price per kw.-hr. will give greater superiority to the electric truck by a gradually increased mileage.

Again, compare if you will, the space occupied for fuel. The baled hay and oats necessary for a team of horses in the month will require one hundred cu. ft., while the gasoline, 20 cu. ft., and the energy supplied by transmission wires to the batteries—no storage space.

Again, compare the cost per mile traveled:

Power	Type	Cost per Mile.
Gasoline		27 1/2c
Horse	1000 lbs.	25 1/2c
Electric		23c
Gasoline		37 1/2c
Horse	4000 lbs.	35c
Electric		30 1/2c
Horse		46c
Gasoline	7000 lbs.	43c
Electric		36 1/2c
Horse		59 1/2c
Gasoline	10,000 lbs.	51c
Electric		45c

From a careful consideration of the above figures, it is evident that the solution of the transportation problem for all farming purposes is the general use of electric current permitting the economy to the farmer that is possible in cities by the use of the electrically propelled vehicle, and that a liberal policy of the quasi public utilities in line extension and generous demonstrations will indicate clearly that cooperation is more than a meaningless term in all problems, urban and rural.

WIRELESS CIRCLES GLOBE.

Washington, Feb. 20.—Arrangements are being made between the American and Russian governments for the establishment of a regular wireless service across Bering Sea, which will insure telegraphic communication between America and Asia at all times, even in the event of interruption of the cable service. The project, it is said, taken in connection with the existing trans-Atlantic radio service, completes the circuit of the globe by this means of communication.

TELEPHONE SERVICE CHECKS IN WISCONSIN.

BY J. N. CADBY.[1]

Herewith is a sample of the test card used by the inspectors. Whenever inspectors are examining the quality of gas or electric service in any city, they have occasion to use the telephone in calling up parties whom they desire to interview, inquiring for express or regarding the time of trains on which they may wish to depart. These incidental calls are recorded on the test card and since the inspectors are equipped with split second stop-watches they can easily give accurate data regarding the time elapsing before the operator answers and the total time required to get the party from the beginning of the call. All irregularities, such as wrong number given, poor transmission, poor supervision, objectionable noises on the line, or other irregularities in the service are noted. If these incidental calls indicate poor service, the inspector endeavors to make a number of additional calls whenever he can do so without seriously delaying his work.

Whenever the calls sent in incidentally by gas and electric inspectors indicate that further inspection should be made, the regular telephone inspector makes 50 to 100 test calls from the various sections of the city and also visits the exchange and looks over complaint records and operating data before making his report to the office. The test calls made by the inspector are plotted graphically, showing the percentage of calls answered in various intervals of time.

Aside from inspections made on account of the conditions reported by gas and electric inspectors, similar tests are made whenever formal or informal complaints reach the commission. Routine inspections of this kind are also made in the larger cities at least once each year. A report to the telephone company setting forth the findings of the inspector follows each regular inspection. If the records are unsatisfactory, a follow-up inspection is made within a reasonably short time. It has been possible by this general method to bring the telephone company officials and employes to watch more closely their quality of service. It has been the commission's desire in this grade of service, as well as in the others, to encourage self-criticism on the part of the operators and supervise in a general way the operation. No attempt is made to inspect service continually and call attention to a great number of individual cases. At the same time, however, the specific incidents are brought to the attention of the management, both by the inspector, after completing his secret test calls, and through correspondence from the office. The reason calls are made secretly is obvious, since entirely normal conditions can not prevail when the officers and employes know that an inspection is being made. The last test call made is always one making an engagement with the manager of the exchange for an interview. The manager under these conditions is able to determine which operators were occupying the various positions at the particular time of the test, the absence of certain operators and the presence of any temporary help which might be necessitated thereby.

[1]Telephone expert for the Railroad Commission of Wisconsin.

Wherever poor service has been observed, it has been possible to bring about satisfactory improvement within a reasonable time without the necessity of formal action. In case any telephone company fails to make reasonable and prompt improvement in service, formal action would probably be resorted to.

After the first year's inspections were completed, a general letter was sent to the various exchanges in the cities having over 10,000 population. This was in December, 1909. In this general letter it was stated that the average time to answer calls denoted to a fair degree the character of service. In the larger exchanges, which were included in the first year's tests, it was found that the service of the best exchanges was such that the average for 100 test calls was in the vicinity of four seconds. That 80 to 85 per cent of these calls were answered within 5 seconds and that 5 per cent were answered within 7 seconds. The time of the slowest answers did not usually exceed 12 seconds. The size of the city or the size of the exchange did not seem to affect these values very

4-30-11-2M FORM [illegible]

JOINT ENGINEERING DEP'T
WIS. TAX & R. R. COMMS.

Telephone Service Inspection

City.................Name of Co.................................. Date............Insp.............

	Party Called		Time to Ans.		Time of Test	Call Made From
	Number	Name	By Cent.	By Party		
1						
2						
3						
4						
5						
6						
7						
8						

(ALWAYS CALL R. R. STATIONS) (OVER)

Inspector's Card Used by Wisconsin Commission.

materially. It was found that where the service was prompt, the operators in general were accurate and that they frequently repeated the numbers correctly and supervised the calls very well. After business hours and on Sundays the service was somewhat slower and less regular than the above indicates. Companies have been encouraged to have operators use standard phraseology, repeat numbers accurately disconnect as promptly as possible after the conversation was completed and supervise all calls not promptly answered by the party called. Out of date directories were mentioned and where better equipment was needed or where the equipment was not kept in first class operating condition, the same was called to the company's attention.

We feel that the above plan of inspecting telephone service has considerably improved conditions throughout the State. Most of the attention up to the present time has been devoted to city exchanges, but recent complaints and investigations have shown that the rural communities are greatly in need of better service and for that reason the staff will devote considerable attention during the next year or two to the raising of the quality of telephone service in rural communities. Six gas and electric service inspectors turn in incidental inspections, and one man spends most of his time on telephone service and is able to carry on practically all the field tests not made by the gas and electric inspectors.

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POWER AND GAS

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Passing of the Boiler Horsepower

The passing of the unit known as the "boiler horsepower" is indeed a significant step in the direction of simplifying engineering computation. The recent action of a joint committee representing the American Institute of Electrical engineers and the American Society of Mechanical Engineers recommending the substituting in its place of the myriawatt emphasizes two important steps accomplished in engineering evolution. In the first place a cumbersome and irrational factor is thus to be torn from engineering routine. Again, this first act of joint standardization work by the two great national engineering societies gives promise of being the forerunner for much greater simplifying effort in the near future. The many other empirical and irrational ratings and units employed might well be abolished along with the boiler horsepower, such as the complicated systems used to express the gravity of fuel oils, the conflicting definitions of the British thermal unit, and a host of others.

The new unit to be used to replace the boiler horsepower is to be known as the "myriawatt," derived from the Greek "myria," meaning ten thousand. Thus, a myriawatt is 10,000 watts, or 10 kilowatts.

In the early days of the steam engineer, before any rational basis was proposed, to give the same rating to the boiler irrespective of losses as determined from the indicated horsepower of the steam engine, became popular as a rule of the thumb. Thus, a boiler that could supply steam to operate a steam engine developing 50 indicated horsepower was said to be a fifty horsepower boiler. Later it became evident, due to the rapidly increasing efficiency of the steam engine that such a rating was wholly variable. Hence, it was determined that a boiler supplying 30 lb. of steam per hr. at 70 lb. pressure from feed water at 100 degrees F. developed an indicated horsepower in the average steam engine of the day. In the further evolution of steam engineering, pressures and temperatures became so variable and the steam engine so improved in efficiency that the A. S. M. E. Committee on Boiler Tests in 1884 defined the boiler horsepower as being equivalent to the evaporation of 34.5 lb. of water at 212 degrees F. into steam at 212 degrees F. By referring to the recent researches of Marks &Davis, defining the British thermal unit as 1/180th of the heat necessary to raise 1 pound of water from 32° F. to 212° F., it is found that each pound of water evaporating into steam at 212 degrees F. absorbs 970.4 B.t.u. of heat energy. Hence one boiler horsepower thus becomes equivalent to the absorbing of 33,479 B.t.u. of heat energy per hour.

The ordinary horsepower known throughout the world is equivalent to 2547 B.t.u. per hr. Hence the boiler horsepower is a unit 13.14 times the ordinary horsepower—wholly irrational and without any excuse for existence, save what tradition and common practice might dictate.

Due to the popularity and growing use of the steam turbine, the output of which is of necessity expressed in kilowatts in order to mate with the distributing units electrically supplied, a conflict thus arises between input and output language of expression. The

myriawatt or 10,000 watts, being equivalent to 34,150 B.t.u. per hr., offers a scientific unit for substitution, which is only 2 per cent larger than the former irrational and empirical unit known as the boiler horsepower. Although it is still to be regretted that the myriawatt does not yet make output and input expressible in like units, still a factor of ten furnishes a basis readily convertible, and makes possible a change in units without materially upsetting the old boiler horsepower range of capacity.

Golden Poppy Special No. 2

"The poppy," says the Standard Dictionary, "is a showy herb of the Old World, a few species being cultivated and sparingly naturalized in the New." As an instance of what a "showy herb" can accomplish, however, a brief reference to Oriental history will prove of interest. In 1839, the government of China being desirous of preventing the use of opium, extracted from the poppy, destroyed a great quantity of this sleep-giving drug.

The opium proved to be the property of British merchants. Hence, this destructive act led to the first war with England and ultimated in the opening of China and Japan to the commerce of the world. John Smith in his dictionary of popular names of plants properly concludes, therefore, that the poppy with tea, sugar, tobacco, and cotton plants, has been an important agent in changing the political and social condition of nations.

And, so it is that the few species of this "showy herb," which, as stated above, is being cultivated and sparingly naturalized in the New World, projected a trip to the Seattle convention of the National Electric Light Association last June, which proved so profitable, so wholesome and withal embodying so many of the underlying characteristics of any important agent which exerts its influence in changing the "political and social conditions of nations," that a second Golden Poppy Special will set forth to the Chicago convention in the latter part of May in the current year.

It is in this enlarged interpretation that tone is given the apt naming of this symbol of Western enterprise. The poppy, the state flower of California, connotes to the thinking mind the days of forty-nine and the golden opportunities of past, present and future in that great district lying west of the Rocky Mountains. It speaks for the coming days of 1915, and for the second calling of the N. E. L. A. convention to a Western port in that year of years. Above all, too, it speaks not alone of filthy money value but, as gold is most often found in nature in the pure unadulterated state and is difficult to fuse with baser metals, so the the Golden Poppy Special No. 2 would carry again to the representatives of this great gathering of national power and lighting interests, the emblem that moves nations to action and enterprise; and the golden poppy, symbolic of the pure unadulterated opportunities offered in that growing world of commercial activity—the West—will once more go forth resplendent in the enterprise and confidence of electrical opportunities on the Pacific Coast.

Again, much is to be gathered by those participating in this excursion from close commingling with our Eastern brothers at an electrical gathering of the proportions contemplated at Chicago in June. The central station executives, pursuing the broad business policy of sending a strong Western delegation to this convention, will reap their reward. New and widening viewpoints are bound to follow and absorbed ideas of Eastern competitive business methods are sure to prove of immeasureable profit when the time arrives to foot up another year's log sheet.

Checks on Telephone Service

One of the most beneficial results of the Wisconsin commission supervision, both to corporation and public alike has been the splendid telephone service there instituted. Promptness in answering calls is dependent upon many variables. In Wisconsin the railroad commission employs a telephone expert whose duty it is to make periodic tests and follow up complaints of every nature so far as they may pertain to the telephone service. The history and accomplishments of this unique institution in Wisconsin is interestingly related on another page of this issue by the man having this important work in charge.

Complaints were seemingly so broadcast throughout certain districts on the coast relative to telephone service, the editorial force of this journal has undertaken the gathering of definite data to determine the justification of such murmurings. After having secured the letter from Wisconsin, published in this issue, a number of tests were put through in and about the bay region of California agreeable to the inspector's card as published elsewhere. The average of the tests as gathered showed 8.5 seconds elapsing before a reply from central and a total of 24.4 seconds before reaching the central of the party called. In Wisconsin the service of the best exchanges is found to be four seconds. Furthermore, 80 to 85 per cent of their calls are answered within 5 seconds, and their slowest answers do not usually exceed 12 seconds. The one pleasing result of the informal tests put through in California as indicated is that a material improvement in service during the past fortnight is indicated. Still, there is yet absolutely no comparison between the results attained in California and those in Wisconsin.

That the regulating commissions in California and other Western states should institute similar inspection to that maintained in Wisconsin can no longer be questioned. The telephone authorities themselves should welcome such procedure. Indeed a prominent telephone engineer when recently discussing commission regulation before one of the western branches of the American Institute of Electrical Engineers himself spoke of the high regard in which commission telephone inspection is held by the telephone authorities in Wisconsin. He described the pride with which various operators held themselves always in readiness in order to appear high up upon the reports of the commission inspector.

Along with the intense subject of rate discussions, the regulating commissions should not overlook this function of inspection theirs by law. Minimum cost is desirable, but meanwhile every co-operative aid should be extended in order that maximum service may be rendered.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. H. Manny of the Manny-Myers Company at Seattle is visiting California.

F. N. Averill of the Fobes Supply Company at Portland, is at San Francisco.

W. H. Leffingwell, chief engineer with the Mono Power Company of Bishop, Cal., is at San Francisco.

A. L. Havens, manager of Pierson, Roebing & Co.'s Los Angeles office, was a recent visitor in San Francisco.

Jesse W. Churchill of the California-Oregon Power Company, with headquarters at Yreka was at San Francisco this week.

A. B. Saurman, Pacific Coast manager for the Standard Underground Cable Company has returned from a brief Eastern trip.

A. J. Myers, Pacific Coast manager for the Wagner Electric Company, has returned from an extended trip through the East.

M. M. O'Shaunessy, city engineer for San Francisco, is at Washington, D. C., to represent the city at the Hetch Hetchy water hearing.

Geo. A. Campbell, general manager Truckee River General Electric Company at Reno, Nevada, was at San Francisco during the past week.

Roy Worth has taken charge of the Seattle office of the American Ever Ready Company after over a year's service at the San Francisco headquarters.

R. B. Clapp of the Westinghouse Electric & Manufacturing Company of Los Angeles, and **H. W. Woodill** of the Woodill & Hulse Electric Company, are at New York.

H. B. Kirkland, general sales manager of the American Conduit Manufacturing Company of Pittsburg, Pa., and Fifth Jupiter of the Jovian Order, attended the meeting of the Pacific Coast Electrical Jobbers' Association at Del Monte this week.

Ross Hartley, Portland manager for the Pacific States Electric Company, and **F. N. Killam**, manager of the Seattle house, were in attendance at a conference of sales managers at San Francisco during the past week and later attended the jobber's meeting at Del Monte.

E. C. Bradley, vice-president and general manager of the Pacific Telephone and Telegraph Company, has announced his intention of resigning at the annual meeting of the stockholders March 5th, with a view of retiring from active life, after forty years' service. He started as a telegraph operator and in time became third vice-president of the Postal Telegraph Company. Later he was associated with the American Telephone and Telegraph Company in Boston and New York, and then came to the Pacific Telephone and Telegraph Company.

Fifty business men of San Francisco made a trip to the high Sierras Washington's Birthday under the direction of the Pacific Gas & Electric Company. The party returned full of anecdotes of its pleasant journey. For the most part the excursionists were representatives of the gas and electric appliance houses of the city and the trip was taken to show them the site of the big dam which the Pacific Gas & Electric Company is erecting at Lake Spaulding, within a few miles of Emigrant Gap. The names of the boosters' delegation were as follows:

C. C. Beattie, C. D. Steiger, J. E. Crilly, D. E. Harris, C. E. Murphy, J. H. Hunt, R. McIntyre, W. L. Neelands, E. H. Coleman, L. Fitzpatrick, E. Brandon, T. Haskins, H. Heitmuller, L. Fotreau, P. T. Sprague, D. Davis, M. Blum, G. Scheer, E. A. De Lue, K. Welbach, J. Francisco, H. Stratford, F. Leahy, F. McGovern, G. I. Williams Jr., C. Elsasser, H. Rowe, N. Ware, R. B. Swayne, H. S. Norman, W. R. Dunbar, F. Wooll, R. W. Martindale, S. Gilman, H. B. Mills, L. R. Edwards, E. G. de Wald, J. G. Reid, J. R. Thompson, T. F. Leary, D. T. Blair, C. A. Lamb, F. Pierce, G. Muir, L. A. Nott, N. E. Otterson, W. E. Mushet, George D. Monaghan, E. O. Mahoney, G. Murphy.

H. R. Noack, president and general manager of Pierson, Roeding & Co., announces that **S. K. Colby**, vice-president of the company, has also become associated with the firm of Allen & Peck Inc. of New York City, as one of the vice-presidents. Mr. Colby will retain his interests and title with Pierson, Roeding & Co., and there will be no further changes in the personnel of this well-known firm, which has come so much to the front in electrical matters on the Pacific Coast under the able direction of Mr. Noack during the past fifteen years. Since his graduation from the Renesselaer Polytechnic Institute in 1894, Mr. Colby has been actively connected with some of the largest public service corporations and electrical manufacturers in the country, particularly in connection with electric railway work. In 1895, he became engineer in charge of construction for the Troy & New England Railroad, an eight-mile electric railway project, and later became assistant to the manager of the New York office of the Pittsburg Reduction Company, which afterward became the Pittsburg Aluminum Company of America. Within less than two years he had charge of the New York office, resigning in 1905 to become treasurer, and later vice-president and half owner of the firm of Pierson, Roeding & Co., who represent a number of well-known manufacturers on the Pacific Coast, specializing in power transmission and railway equipment. These include the J. G. Brill Company, The Aluminum Company of America, the Electric Storage Battery Company, the Locke Insulator Manufacturing Company, the Fibre Conduit Company, the Lombard Governor Company, the R. D. Nuttall Company and the tower department of the American Bridge Company, thus giving him an intimate acquaintance with most of the electrical constructions in the western part of America. He has played an important part in the development of aluminum as an electric conductor, and has been closely associated with electric railway developments on the Pacific Coast. In October, 1912, he was elected a member of the Executive Committee of the American Electric Railway Manufacturers' Association, also being an associate member of the American Institute of Electrical Engineers and an associate member of the American Society of Civil Engineers.

ELECTRICAL DEVELOPMENT AND JOVIAN LEAGUE.

At a special meeting of the Electrical Development League held February 25 the amended by-laws were adopted, which completes the affiliation of the Jovian Lunch Club with the League, and the united bodies will hereafter be known as the Electrical Development and Jovian League. Mr. T. E. Bibbins was elected president; C. C. Hillis, vice-president, and E. B. Strong, secretary-treasurer, of the new organization. Messrs. Geo. C. Holberton, W. L. Goodwin, F. H. Woodward and Frank Watts, members of the Executive Committee. Judge Thos. De Bevoise of New York, counsel for the Electrical Jobbers' Association, is to address the League Monday, March 3, on the subject, "Our Competitors in Business." A record-breaking attendance is anticipated.

PACIFIC COAST CONVENTION OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the request of the Institute members in Vancouver and vicinity, the Board of Directors has authorized the holding of the annual Pacific Coast Convention of the A. I. E. E. at Vancouver, British Columbia, on September 9, 10 and 11, 1913. The Vancouver Section has been working for some time in preparation for this convention, and has already arranged for a number of papers, and plans are maturing for interesting trips to some of the large hydroelectric installations in the vicinity of Vancouver. Arrangements are being made for special rates over all railroads, and as this will afford to the engineering fraternity an excellent opportunity for visiting this region so interesting from the point of view of hydroelectric development, it is expected that a large attendance from the East, as well as from the West, will be assured.

A. I. E. E. LECTURES ON RADIOACTIVITY.

It has been found necessary to change the dates for the series of lectures on "Radioactivity" to be given by Professor Edwin P. Adams of the Palmer Physical Laboratory of Princeton University, under the auspices of the Electrophysics Committee of the Institute, of which preliminary announcement was made in a previous issue. The lectures will be given at 8:15 p. m. on Wednesday evenings, March 19 and 26, and April 2 and 9, in the auditorium of the Engineering Societies Building, 33 West Thirty-ninth street, New York.

Following is an outline of the topics to be treated in the four lectures:

Lecture I—March 19.

The discovery of the property of radioactivity.

Radium and its preparation.

Ionization of gases.

Nature of the radiations from radioactive substances,—alpha, beta and gamma rays.

Lecture II—March 26.

The disintegration theory of radioactivity.

The distribution of radioactive substances.

Radium and the age of the earth.

Lecture III—April 2.

Dependence of the mass of an electron on its velocity.

The electron theory of matter.

Electrons in optical theory. Zeeman effect.

Emission and absorption of light.

Lecture IV—April 9.

Metallic conduction.

Indication afforded by the study of radioactivity regarding the structure of the atom.

Optical phenomena in moving bodies.

The principle of relativity.

The lectures will be open to the membership of the Institute. The members of the American Society of Mechanical Engineers, The American Society of Civil Engineers, The Electrochemical Society, and the Illuminating Engineering Society have also been invited.

Oregon Technical Club.

The last luncheon to be held at the Portland Hotel took place on Tuesday, February 18th. The luncheons in the future will be held at the Commercial Club. J. H. Morton was chairman of the day and D. C. Henny, consulting engineer for the Reclamation Service in the Northwest, was the speaker. He made an able address on "Points That Controlled Irrigation in the West.". "People are impatient with the delays in big enterprises; they expect immediate results," said Mr. Henny. "They also fail to see that there is a growing cost an acre as the more difficult tracts are watered. A survey of the whole movement leads us to trust that the inherent difficulties of reclamation will be understood better as time passes, and that the essential principles by which Federal, state and community work may be secured will not be put aside without a careful study of the history of irrigation procedure."

W. D. Scott of the Pacific Telephone & Telegraph Company will be chairman of the next luncheon and W. J. Phillips will be the speaker. His subject will be "Moulding Public Opinion Along Engineering Lines."

San Francisco Engineers' Club to Be in Permanent Quarters.

On last Tuesday noon at the Palace Hotel in San Francisco, the Engineers' Club unanimously voted to acquire permanent quarters, for the present at least, in the Balboa building. The club will be served by the Hoffman Cafe. It is now believed that this act will ensure a rapid and elivening growth in the organization and within a year that more substantial quarters may be secured. The quarters decided upon are certainly centrally located and all present were enthusiastic over the final decided step that was taken.

Portland Jovian Luncheon Club.

The regular Thursday luncheon was held at the Oregon Hotel on February 20th. Mr. G. L. Priest was the chairman of the day and the speaker was W. C. Deitchall, on the subject of "Co-operation in the Contracting Business." Mr. Dietchall represents the Northwestern Trust Company, as superintendent of construction and pointed out the fact that architecture was on a firm footing but that the contracting business in all lines, and the owners, were always made the "goats."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The board of directors of the American Institute of Electrical Engineers held its regular monthly meeting at Institute headquarters on Friday, February 14, 1913, at 3:30 p. m.

The Meetings and Papers Committee submitted a list of places suitable for holding the annual convention for 1913. The board voted unanimously to hold the annual convention in Cooperstown, N. Y., during the week beginning Monday, June 23, 1913.

The board authorized a two-day Institute meeting in Pittsburgh, Pa., during the latter part of April, under the auspices of the Committee on the Use of Electricity in Mines, in cooperation with the Pittsburgh Section. The exact date of the meeting was left to the discretion of the Meetings and Papers Committee, and will be announced later.

In view of the unusual activity incidental to the holding of the Midwinter Convention in New York, February 26-28, 1913, and the lectures on radioactivity to be given under the auspices of the Institute's Electrophysics Committee on Wednesday evenings, March 19th and 26th, and April 2d and 9th, it was voted to omit the April New York meeting, so that the regular meeting scheduled for Friday, April 11th, will not be held.

The lectures on radioactivity had previously been announced for Tuesday evenings during the latter part of March and April, but upon recommendation of the Meetings and Papers and Electrophysics Committees, the dates were changed to Wednesday evenings, March 19, 26, and April 2 and 9.

One hundred and one Associates were elected and eighty students were ordered enrolled.

One hundred and fifteen Associates and eighty-two Members were transferred to the grades of Member and Fellow respectively.

Upon the recommendation of the Sections Committee, the organization of a Section was authorized at Spokane, Wash., in response to a petition signed by twenty-five Members and Associates residing in that territory.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

STANDARD SPECIFICATIONS FOR WIRING BUILDINGS.

(Continued.)

Example No. 1. (For conduit work in a store and office or hotel building in the underground district, having marble main switchboard, and both master meters and check meters).

Service:

The Portland Railway, Light & Power Company will bring 120-240 volt direct current lead covered service cables into the basement at the point shown on plans, and furnish and install a service switch and cutout.

From this point the wiring contractor is to run three conductors for the entire service to the master meter-board, and do the necessary wiring on same as required and specified by the Portland Railway, Light & Power Company.

From the master meter-board the contractor is to run three conductors for the entire lighting service to the main lighting switch and cutout on the main switchboard.

From the master meter-board the contractor is to run two conductors for the entire power service to the main power switch and cutout on the main switchboard.

Main Switchboard:

In the basement, at the point shown on plans, a main switchboard is to be furnished and installed bearing metal name plate of electrical contractor, and consisting of the necessary panels of marble or slate, free from mineral veins or any other imperfections that would render it undesirable electrically, and supported on an angle iron frame.

The board is to be placed at least three feet from the wall so as to provide working space for testers and other workmen.

On the rear of the board the necessary bus bars are to be provided; said bus bars to be furnished with substantial supports, well insulated.

On the face of the board the switches, cutouts, etc., enumerated below are to be furnished and installed; no switch to have a capacity of less than twenty-five amperes.

(a) One main line 3-pole knife switch and enclosed fuse cutout for the whole lighting system.

(b) One main line 2-pole knife switch and enclosed fuse cutout and meter for the 240 volt power service.

(c) six 3-pole knife switches and enclosed fuse cutouts and meters, one for each of the six feeders to the stores.

(d) Six 3-pole knife switches and enclosed fuse cutouts and meters, one for each of the sign feeders for each of the six stores.

(e) One 3-pole knife switch and enclosed fuse cutout and meter for the feeder that is to carry the second, third and fourth floors.

(f) One 3-pole knife switch and enclosed fuse cutout and meter for the feeder that is to carry the fifth, sixth, seventh and eighth floors.

All switches to be of approved make and to be provided with a suitable name plate indicating service controlled by it.

The switchboard is to be fitted with two suitable bracket lamps with shades so arranged as to illuminate the dials of the meters.

The contractor is to furnish all the necessary fuses for this board and one extra set for each cutout. All fuses are to be of the enclosed type new code fuses, either "Noark" or "D. & W." or equal.

Meters:

Standard General Electric Company's recording wattmeters arranged for side connection will be furnished and installed by the Portland Railway, Light & Power Company. The wiring contractor, however, is to provide space for the check meters and is to furnish and install the necessary meter board on the back of the switchboard for these meters, and to furnish and install all the necessary connections for same; said connections to be taken off mains behind individual feeder switch and cutout.

Lighting Feeders:

From the meter on the main switchboard 3 conductor feeders are to be run as follows:

(a) One to the branch cutout cabinet in each of the six stores.

(b) One of No. 10 rubber covered wire for each of the six sign services above mentioned, to the switches located under the windows in the entrances of the above mentioned stores, and from here to a point over the entrance, and sufficient wire left extending for future connections to signs.

(c) One to the branch cutout cabinets on the second, third and fourth floors.

(d) One to the branch cutout cabinets on the fifth, sixth, seventh and eighth floors.

Power Feeders:

From the meter on the main switchboard a feeder is to be run to the various elevator and ventilating system motors as follows:

(a) Three 20 h.p. elevator motors at the foot of the elevator shaft in basement.

(b) One h.p. ventilating system motor in room for same in basement, as shown on plans.

(c) One 5 h.p. ventilating system motor in the south wing of the fifth floor, at the point shown on plans.

(d) One 2 h.p. ventilating system motor in kitchen on the eighth floor, at the point shown on plans.

These feeders are to be run to the points indicated and terminated in switch cabinets consisting of No. 12 sheet steel, thoroughly stiffened with angle iron, and furnished with doors made up of No. 10 sheet steel, fitted with suitable spring latches, and hinged at the top so that same will be self closing. In these cabinets are to be mounted proper switches and cutouts and provision made for future connection of motor leads.

Cutout Cabinets:

On each and every floor, from the first to the top floors, (both inclusive) and at positions shown on plans, cutout cabinets are to be furnished and installed, the frames of which are to be made up of No. 14 sheet steel, thoroughly stiffened with angle iron, and furnished with doors made up of No. 12 sheet steel, fitted with suitable spring latches, and hinged at the top so that same will be self-closing. In these cabinets are to be mounted standard fuse plug cabinet panels furnished with the necessary linings. Those panels are to be made up of highly polished black enameled slate, free from metallic veins or other faults, and having mounted thereon all the necessary copper bus bars to feed the various circuits, and arranged for 3-wire mains and 2-wire branch circuits. Each panel is to be fitted with a main switch and enclosed fuse cutout.

The contractor is to furnish all necessary fuses for all panel boards, main line fuses being of the enclosed cartridge type and the branch fuses of the Edison plug type. An extra set of fuses for each of the cabinets is to be furnished by the contractor.

In all the cabinets furnish connections for two circuits in addition to present requirements, same being for future use.

Each circuit is to be numbered in some permanent manner, and a neat schedule showing the number or name of the rooms or outlets to which the various circuits run is to be furnished on the inside of the door of each cabinet, being held in place by means of a suitable frame. After the cabi-

nets are set up and all connections made they are to be thoroughly cleaned out and painted with an approved black paint.

Branch Circuits:

From the cutout cabinets necessary branch circuits are to be run to feed the various outlets as shown on plans.

Curved lines shown on plans connecting outlets indicate that connected outlets are to be on the same circuit. Where no such connection lines are shown, contractor may wire for such outlets in the most practical manner.

From the branch cutout cabinet on the second floor the necessary branch circuits are to be run to the outlets for lamps in the main entrance on the first floor and the outlets in the building or common basement.

From the branch cutout cabinet in each of the .... stores the necessary branch circuit or circuits are to be run to the outlets, as shown on plans, in the basement under each of the ...... stores.

Note:—If the desired location of these outlets is not known, clause (51) can be written as follows: From the branch cutout cabinets in each of the ...... stores, two (or more) branch circuits are to be run down into the basement for future extension, sufficient wire being left hanging below the ceiling to provide easy connection.

All hall lights are to be on separate circuits from those in the rooms.

The branch circuits to the window and entrance lights and signs are to be run to switches located under the windows in the entrances to the various stores. The window circuits are to be run from these switches eight feet up the window casing, and sufficient wire left extending to provide connection for future window lamps. The circuits for the entrance lamps are to be run from their switches to the outlets in the entrances.

Switches:

All circuits and outlets not mentioned below are to be controlled by the double pole knife switches in cutout cabinets.

All ceiling outlets connected by curved lines to switch outlets which are indicated thus ("S") on plans, are to be controlled by flush push button switches with face plates to match other hardware.

Window circuits, entrance circuits and sign feeders in stores are to be controlled by flush rotary snap switches placed in the panels under windows in entrances, the switches to be provided with locking attachments with keys for same in order that such circuits may be controlled from the exterior of the building.

One of the store basement circuits in each of the stores is to be controlled by a rotary snap switch placed on the wall at the head of the stairs.

The lamps in the common basement near the foot of the basement stairs are to be controlled by a rotary snap switch placed just inside of the door leading to the basement from the main entrance.

The lamp in the main entrance is to be controlled by a rotary snap switch placed beside the last mentioned switch.

All ceiling outlets in the rooms on the second floor and above are to be controlled by flush push button snap switches located as shown on plans, with face plates to match other hardware.

(To be continued.)

ELECTRICAL ORDINANCES IN SMALL OREGON CITIES.

Electrical ordinances have been recently passed by the cities of Medford, Grants Pass, Ashland and Hillsboro, Oregon. The great difficulty experienced in small cities is to find some one who is capable of holding the position of inspector in an intelligent and efficient manner.

The following is the form of ordinance which has been used in the above cities:

Section 1.—It shall be unlawful for any person, or persons, firm or corporation to introduce any electric lighting, heating, or power wire, circuit or circuits, apparatus in or on any building, or awning, structure or addition thereof, within the corporate limits of the city of............unless the same shall be in conformity with the rules and regulations set forth in what is known as the National Electrical Code, being rules and requirements for the installation of electrical wiring and apparatus for electric light, heat and power, as the same are now established, together with any amendments and changes made from time to time, are hereby adopted and approved. Before any such electric wiring shall be commenced in or on any building, awning, structure or addition thereto, a written permit must be obtained from the ....of said city, authorizing the person or persons, firm or corporation, therein named to do and perform the said electric wiring, and designate the location where the same is to be performed. No such electric wiring shall be commenced as aforesaid, until said permit has been obtained.

Section 2.—After any electric wiring shall have been completed in or on any building, awning, structure or additions thereto, for which a permit has been issued, the person or persons, firm or corporation who performed the same must immediately notify .... of the completion of the work, and must keep said work open for inspection by and until he shall have examined and approved the same, and issued a certificate of such inspection. It shall be the duty of the .... upon receiving said notice to inspect said electric wiring, and if the same has been performed in accordance with the rules and regulations as set forth in the National Electrical Code, as herein and before mentioned, he must issue a certificate to such effect, and deliver the same to the person or persons, firm or corporation having done said wiring, but if not performed in accordance with the said rules and requirements, he shall withhold such certificate until all defects are remedied.

Section 3.—.................... shall have the rights to enter into all buildings where electric current wire exists for the purpose of inspecting the same.

Section 4.—The said .... is hereby empowered to inspect or reinspect all wiring in or on buildings and apparatus conducting electric current for light, heat and power, and when said conductors or apparatus are found to be unsafe to life and property he shall notify the person, or persons, firm or corporation, using or operating them to place the same in a safe and secure condition within forty-eight (48) hours. Any person or corporation failing or refusing to repair, change or remove same within forty-eight (48) hours, or within such further time as the .... deems necessary, after receipt of such notice, shall be subject to the penalty hereinafter provided.

Section 5.—All installations, changes, alterations, extensions, or repairs to existing electric installations made previous to the adoption of this ordinance, shall be done in accordance with the hereinbefore mentioned rules of the said National Electrical Code.

Section 6.—Any person, or persons, firm or corporation, who shall violate any of the provisions of this ordinance shall be deemed guilty of a misdemeanor and upon conviction thereof before the city recorder shall be punished by a fine of not exceeding fifty dollars ($50) or by imprisonment in the city jail of Oregon, not exceeding twenty-five days, or both fine and imprisonment.

Section 7.—All ordinances or parts of ordinances in conflict herewith are hereby repealed.

NEWS OF THE ELECTRICAL CONTRACTORS.

The W. H. Smith Electrical Engineering Company, 1003 Spalding building, Portland, has been incorporated by W. H. Smith and associates. The company is now in a position to undertake the installation of electrical machinery, the building of power plants and the electrical equipment of buildings. The contract for doing the wiring and installing electric motors in the University Club building, Portland, has been awarded this company.

The Oregon Hotel annex at Portland, has installed an isolated plant equipped with three 100 kw., Allis-Chalmers Company 3-wire generators, 120-240 volts, directly connected to three Skinner engines; the switchboard being furnished by the Allis-Chalmers Company also. The boilers were furnished by John Brennon & Company, Detroit, Michigan. The installation work was done by the H. M. H. Electric Company

of Portland, Oregon. The electrical installation in the rest of the building was installed by the Pacific Fire Extinguisher Company. The switchboard was furnished by the A. G. Electric Manufacturing Company, Seattle, Wash., for the building proper.

The Multnomah Hotel at Portland has installed one unit of an isolated plant, consisting of one 75 kw. Crocker-Wheeler Company's 3-wire d.c. generator, 120-240 volts, directly connected to a Ball Engine Company's compound engine. This installation was installed by the Pacific Electric Engineering Company, just before they went into the hands of a receiver.

The plant in the new Multnomah county court house is composed of the following 1-75 kw. Crocker-Wheeler Company's d.c. 3-wire generator, 120-240 volts, directly connected to a 12 x 16 Pheonix Iron Works Company's simple engine, located in Meadville, Pa.; 2-150 kw. Crocker-Wheeler Company's d.c. 3-wire generator, 120-240 volts, directly connected to Pheonix Iron Works Company's tandem compound engines, 13 x 16 and 22½ x 16. The plant is also equipped with Scotch marine boilers, built by the Pennsylvania Steel Company, and equipped for oil burning. The switchboard was built by the H. G. Electric Manufacturing Company, Seattle, Wash. This electrical installation, as well as the last half of the building electrical installation, was installed by the Pacific Fire Extinguisher Company.

The electrical contract for the Portland city jail has been awarded by the executive board of the city council to W. L. Bradley & Company, of Portland, Oregon, for the amount of $11,245.

McMEEN & MILLER INCORPORATED.

The well-known engineering firm of McMeen & Miller, which for the past ten years has existed as a partnership between Samuel G. McMeen and Kempster B. Miller, has been incorporated under the same name. The personnel of the new firm includes Mr. McMeen and Mr. Miller, the former partners, and as a new member Mr. Leigh S. Keith, who for a number of years has been connected with the firm in the capacity of managing engineer.

The incorporation of this firm comes as the result of its constantly widening field of operations. The old partnership was established, primarily, to conduct a general telephone engineering and patent expert practice. Mr. McMeen and Mr. Miller were the first engineers to establish themselves in a general telephone engineering business, detached from all manufacturing and operating concerns. The scope of the concern has rapidly widened, so that the greater bulk of the work of the firm for a number of years has been in the line of consultation, design, construction and management in connection with properties in the railway, light and power fields, and investigations of public service corporations for private and municipal interests.

Mr. McMeen, who is the senior member and vice-president of the new firm, is well known as one of the pioneer telephone men of the country, having served the Central Union Telephone Company in all capacities from operator to chief engineer. Later he had wide manufacturing experience with the Western Electric Company, and since entering into partnership with Mr. Miller, has become well known as a designer and constructor, and as an executive of public service corporations. Among the more recent notable work done by Mr. McMeen might be mentioned the engineering, construction and subsequent executive management of the San Francisco Home Telephone Company, and his services as president of the Mount Hood Railway and Power Company, of Portland, Oregon, during the later stages of its plant construction and previous to its consolidation with the Portland Railway, Light and Power Company.

He is at present located at Columbus, Ohio, where he is devoting practically his entire attention to the affairs of E. W. Clark & Co., of Philadelphia. He is president of the Columbus Railway and Light Company, one of the Clark properties, and has the executive management of all of the allied electric properties in Columbus. He also serves in an advisory capacity in the Clark properties throughout the country.

Mr. Miller, who is president of the new firm, is perhaps best known to the world as the author of "American Telephone Practice," for many years considered the standard treatise on telephony the world over. Mr. Miller, after graduating from Cornell, served a short apprenticeship in the lighting and power departments of the Thomson-Houston and Westinghouse factories, then entered the telephone manufacturing field in Chicago, and for many years was identified, as engineer and manager, with the Kellogg Switchboard and Supply Company. Since entering the field of general consulting engineering, his talents have been directed to a wide variety of works, some of them of notable importance. He has devoted much of his attention to special investigations of public utilities, both from the engineering and financial standpoints. He is general manager of the Central Oregon Power Company and is at present devoting much attention to the development of hydroelectric projects on the Deschutes River, in Oregon. He is also acting as consulting engineer on special problems for a number of electric railway, light and power companies, particularly specializing, in this connection, on the subject of electrolysis of underground structures.

Mr. Leigh S. Keith, the secretary-treasurer of the new firm, is a graduate of Massachusetts Institute of Technology. For a number of years after graduating he was employed in the engineering department of the New York Telephone Company, the later years of this service being spent in the making of special investigations directly under the chief engineer. About four years ago he entered the employ of McMeen & Miller, and has been engaged in a wide variety of engineering work particularly relating to public service investigations of light, power and telephone properties, and various special problems in the field of electric railway work, such as the location of substations, the design of feeder systems and the prevention of electrolysis. For the past three years he has been managing engineer of the firm, so that in becoming one of the principals the change involved is more of name than a function.

The organization of the company has been increased so as to include a full corps of experienced engineers fitted in every way to handle properly, not only the general work of a consulting engineering business, but also the more specialized details of economical and efficient design and construction of steam or hydroelectric stations, high-tension transmission lines and overhead and underground distribution systems.

NEW CATALOGUES.

An attractive bulletin, in colors, recently issued by the General Electric Company, is devoted to the subject of Edison Mazda Sign Lamps. The number of the bulletin is A4072, Bulletin No. A4081 is devoted to the subject of Reversing Motors for Planers, Slotters, etc. Bulletin A4083 is devoted to the subject of US-13 Roller Bearing Trolley Bases, and supersedes the company's previous bulletin of this subject. Bulletin No. 4085 describes more or less briefly that company's Battery-Charging Motor-Generator Sets for Railway Signaling. Bulletin No. A4086 is devoted to the subject of Circuit Breakers for Railway Service, Type MR. Bulletin A4070 illustrates and describes that company's Electrically Operated Remote Control Switch, Type R, Form C2, which is adapted for use wherever control from a central point is desired. It is made for both alternating and direct current.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Chemical Electric Light & Power Company, $1,000,000, shares $1 each, subscribed $5, by T. L. Croon, C. H. Hogg, J. B. McKenzie, L. A. Boyer, E. M. Hogg.

LOS ANGELES, CAL.—Fair View Farms Water Company, capital stock $50,000; stock already subscribed, $175; G. R. Horton, R. P. Jennings, V. E. Rising, R. L. Hanley and C. L. Haskell, directors.

LOS ANGELES, CAL.—Inyo County Water & Power Company; capital stock $200,000; stock already subscribed, $43; Louis Luckel, James MacLachlan, L. A. Cronk, G. R. Pendell, J. E. Pettijohn and E. T. Lyon, directors.

ASTORIA, ORE.—The Mountain Springs Water Company has been formed by H. G. Thorson, W. A. Currio, W. F. White, of Portland and H. E. Christenson of Seaview, Wash., with a capital stock of $40,000, for the purpose of supplying the towns of Long Beach and Seaview, Washington, with water.

WINNEMUCCA, NEV.—The Nenzel Electric Company has been incorporated with a capital stock of 2500 shares, of a par value of $100 each, with Jos. F. Nenzel, J. T. Sullivan, J. H. Causten and J. Berger as the incorporators. The principal place of business is designated as the Big Meadow Hotel, Lovelock. It is understood that the company will at once begin work on a large power plant at Oreana, which will furnish power for Rochester.

GRANTS PASS, ORE—The Rogue River Public Service Corporation has been incorporated by Geo. Sanders, president; F. M. Fauvre, vice-president; Ovando C. Beebe, treasurer; R. E. Gaut, consulting engineer, and G. W. Soranson, secretary, with principal place of business in Grants Pass, for manufacturing hydroelectric power and providing water for domestic and irrigation purposes. It is said the company will take over the ditches and dams of the old irrigation company and will soon be in a position to assure to Rogue River valley an adequate water supply.

ILLUMINATION.

SANTA ANA, CAL.—The Southern Counties Gas Company will spend about $10,000 on a new gas system in Garden Grove.

VAN NUYS, CAL.—The Pacific Underground Construction Company has a large force of men at work putting in an ornamental light system. The posts will carry 5 clusters each, and are spaced 150 ft. apart.

RIVERSIDE, CAL.—District Manager F. A. Worthley of the Southern Sierras Power Company, estimates that $10,000 will be expended on the corporation's prospective improvements and extensions at Elsinore.

LOS ANGELES, CAL.—The board of public works has awarded the contract for furnishing and installing 398 ornamental lighting posts in Seventh street, from Los Angeles River to Hoover street to the Llewellyn Iron Works, for $24,997.60. The board ordered bids advertised for furnishing current.

TRANSMISSION.

NORTH YAKIMA, WASH.—Supervising Engineer C. H. Swigart, of the Reclamation Service, has received authority for the expenditure of $600,000 in the development of Lake Keechelus as a storage reservoir during 1913.

BAKERSFIELD, CAL.—The board of supervisors has passed an ordinance granting to the Southern Sierras Power Company a franchise to erect and operate an electric pole tower and wire system for a period of 50 years in the county of Kern.

BAKERSFIELD, CAL.—The board of supervisors has passed an ordinance granting a franchise to the Pacific Light & Power Company to construct and operate for a period of 50 years electric transmission wires across certain public highways in the county of Kern.

FRESNO, CAL.—The supervisors granted the application of the Pacific Light & Power Company to put up for sale to the highest bidder 50-year franchises for electric transmission and telephone lines from Big Creek across the county public highways. Bids have been called to be opened March 22d.

SAN FRANCISCO, CAL.—Bids were received for the construction of an electrical conduit system in the concessions district of the exposition as follows: Gorrill Bros., $11,070; Williams & Finnigan, $9300; Contra Costa Construction Company, $11,700; Michael Murphy, $14,800; Pringle, Dunn & Company, $12,816; Jas. H. O'Brien, $8460; Pierson-Roeding Company, $9477; Phillip Schuyler, $12,331.

BELLINGHAM, WASH.—The two projects planned by the Skagit power Company, taken over by the Stone & Webster people, are estimated to provide 110,000 horsepower, and Engineer Freeman states that this may be increased at need to 250,000 horsepower. Mr. Furth stated that the Stone & Webster plans call for the development of between 100,000 and 200,000 horsepower. The larger of the two plants planned by the Skagit Power Company calls for a tunnel five miles in length.

GREENVILLE, CAL.—Bond buyers of San Francisco recently sent experts into the North Fork country, near Seneca, to investigate the Indian Valley Light & Power Company project. C. H. Miller, a hydroelectric engineer of San Francisco, has completed an investigation of the water supply and sites, and has left for Quincy on his way to make his report. The project, he declares, will be backed by his people and operations started at once to develop a first unit of 1000 h.p. for the local field. Other units will be added as the field broadens and the ultimate of 3000 h.p. is reached.

TACOMA, WASH.—Advocating that the municipal electric power plants of Tacoma and Seattle be joined, Superintendent J. D. Ross, of the Seattle power plant, recently conferred with the local council. At the conclusion of the meeting the commissioners decided to consider the matter of a connecting line at an early session. Superintendent Ross estimated the cost at $100,000. He said that thousands of dollars' worth of business could be had with the towns along the route of the proposed pole line. About a year would be required in building the line, and the business along it should be equally divided between the two cities, Mr. Ross said.

OAKLAND, CAL.—Superior Judge J. D. Murphey, sitting in Judge Wells' department of the Superior Court, has begun the rehearing of a suit of the city of Los Angeles against the Silver Lake Power & Irrigation Company. The suit was begun in Los Angeles several months ago before Judge Murphey, but was not completed. Los Angeles attorneys are appearing in the case. The city of Los Angeles is suing to enjoin the power concern from constructing a large dam across the Owen River. The property in dispute is in the southern end of Mono county and Los Angeles lays claim to title for the land through patents of the U. S. government.

TRANSPORTATION.

TACOMA, WASH.—City Engineer W. C. Raleigh's new estimate on a car line across tideflats, without furnishing cars, is $30,000.

VANCOUVER, B. C.—A contract has been let for the construction of the subway at the exposition grounds to Mackenzie, Broadfoot & Johnson. Figured cost, $3800.

PORTLAND, ORE.—The city council has granted the Seventh street franchise to the Portland Railway, Light & Power Company. About eight miles of track will be laid and $300,000 expended.

LEWISTON, IDAHO.—The county commissioners have granted a franchisee to F. L. Strum, Lewiston, for an electric railway from Lewiston via Clarkston to Asotin. The line will be 10 miles long and cost about $300,000, to be completed within 18 months.

SAN FRANCISCO, CAL.—No bids were received for the purchase of $120,000 of bonds for the Market street extension of the Geary-street road. Supervisor Jennings introduced a resolution authorizing the city treasurer to attempt to sell those 120 bonds over the counter at par, which was passed to print.

SAN FRANCISCO, CAL.—The South San Francisco Railroad & Power Company has made application to the board of trustees for a franchise to erect and operate a double track, standard gauge railroad in the city of South San Francisco. Sealed bids will be received up to April 7, 1913, for the sale of the franchise to the highest bidder.

SAN FRANCISCO, CAL.—The annual stockholders' meeting of the San Francisco Electric Railways, which owns the Parkside electric railway and the Visitacion Valley electric railroad, was held Monday, and the outgoing board and existing officers were re-elected as follows: Lewis F. Byington, president; John A. Tyrrell, vice-president; John F. Forbes, treasurer; Geo. K. Ford, secretary, and Fred V. Statt.

MARTINEZ, CAL.—A permit to construct an electric line along the county road from Walnut Creek to Danville, and from the latter point through Green, Sycamore and San Ramon Valleys to the Alameda county line has been granted by the Board of Supervisors to the San Ramon Valley Railroad, a subsidiary corporation to the Oakland & Antioch Railway. Work must be completed on the lines within two years.

RED BLUFF, CAL.—E. L. Sisson, secretary of the Sacramento Valley Electric Railroad Company, says that his company expects to begin construction August 1 and hopes to be running trains into San Francisco over the Oakland & Antioch system within the year following. The project contemplates the building of an electric line from Red Bluff to connect with the Oakland & Antoch several miles west of Sacramento. This section will have 160 miles, and the first work will be on this end. It is the plan to build ultimately to Eureka, 160 miles more.

SAN JOSE, CAL.—That the capital necessary for building the San Jose Terminal Railroad which will connect San Jose with its newly acquired port on the south bay will be furnished by an English syndicate, is the announcement of A. S. Appleton, who has just returned from New York. The building of the road will begin within 60 days and will be completed in an unusually short time, owing to the fact that the grading over the ten miles of the line is practically completed. The new electric line will operate in conjunction with a line of barges to San Francisco. Gasoline tugs will be used for towing and automobile trucks, which will call on individual shippers and consignees, both in San Francisco and the country surrounding San Jose, will be shipped without unloading to make deliveries at either terminal and to collect new loads.

SAN FRANCISCO, CAL.—By a unanimous vote the Supervisors adopted the resolution which officially paves the way for the building of municipal street car lines to the Exposition. The resolution puts the Board of Public Works at the task of working out the scheme "to furnish to the Panama-Pacific Exposition a fully equipped municipal system of street railway service." If the final plan meets with the sanction of the supervisors it will remain for the people to say in a bond election whether they want street railways owned and operated by themselves out Van Ness avenue, Stockton street and on Union street. City Engineer O'Shaughnessy has said that the report of the Board of Public Works can be submitted within a month. On that report the ordinance will be drawn calling for a bond issue. An appropriation of $2000 to the Works board for making car plans was passed to print by the supervisors.

WOODLAND, CAL.—That the Northern Electric Company is to complete a network of lines in the Sacramento valley and give quick service between all the more important cities and towns is the information that comes to light through amended articles of incorporation. The projects include 349 miles of new tracks, uniting all towns of the Sacramento valley with San Francisco. The lines from Vallejo to Sacramento and Woodland had already been well outlined, but including important cities of Yolo, Solano, Colusa, Yuba and Butte counties is news. According to the articles, the work to begin this year includes: Sacramento through Woodland, Arbuckle and Colusa to Hamilton City; Chico to Red Bluff and Redding; Vallejo through Napa, Cordelia, Fairfield, Cement, Davis and Broderick to Sacramento, Fairfield to Suisun, a branch line; Suisun through Vacaville and Winters to Woodland; Davis to Woodland; from the main Vallejo-Sacramento line, a branch to Dixon, and from Sacramento to Folsom, from Colusa to Yuba City.

TELEPHONE AND TELEGRAPH.

SAN FRANCISCO, CAL.—Under the new telephone ordinance which will probably go into effect July 1, $300,000 is the estimated saving to the 'phone users of this city, while still allowing the company a return of 6.1 per cent on its invested capital. Under the present rates the company gets 8.9 per cent. If the proposed ordinance is passed with the rates as now outlined the greatest total reduction on business measured one-party lines will be those on which the present rate is $4.50 monthly. This reduction will amount to $21.72 annually on each installation, or a percentage reduction of 28.6 per cent. There is to be no change in the residence phones, the flat rate with unlimited service remaining the same. The total net earnings of the telephone company for the past year were $876,568.61 on the basis of the investment figures. The statement shows a net earning of $479,122.21. The proposed rates provide a possible leeway for an immediate adjustment of rates amounting to approximately $300,000. This leeway is enough so that the company can meet reasonable demands for increased pay on the part of its employes.

SEATTLE, WASH.—Investigation of telephone companies on the Pacific Coast, begun in this city Feb. 21, by a Federal grand jury under direction of Attorney-General Wickersham, will be absolutely impartial and will cover the entire coast. Employes of the Pacific Telephone & Telegraph Company will be examined by the inquisitors just as freely as officers of the independent lines. The only desire of the government will be to arrive at the exact truth concerning the numerous mergers and alleged violations of the Sherman anti-trust law. Such was the statement made by United States Attorney Beverly W. Coiner, following a prolonged conference between himself, Special Assistant John McCourt, Special Agent Charles Pray, of the Department of Justice, and C. J. Pettys, assistant secretary and treasurer of the Pacific Telephone & Telegraph Company, of San Francisco. Pettys, in response to a subpena duces tecum, laid before the investigators his books and records dealing with the mergers of the Bell lines with independent systems. A significant feature of the probe was the fact that none of the general officers of the Bell lines have been called as a witness before the grand jury. The same is true of the general officers of the Pacific or Sunset lines.

PROFESSIONAL DIRECTORY

ALPHABETICAL INDEX TO ADVERTISERS

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Manhattan Elec. Supply Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.
Manhattan Elec. Supply Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Manhattan Elec. Supply Co.
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
Geo.E.DowPumpingEngineCo.
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Cord, Flexible Bell
General Electric Company
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Pierson, Roeding & Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Pierson, Roeding & Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Dow Pump'g Engine Co.,Geo.E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.

Economy Electric Co.
San Francisco, 444 Market

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 726 Mission
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Tungsten, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pierson, Roeding & Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.
Manhattan Elec. Supply Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
Fairbanks, Morse & Co.
General Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Pittsburg Piping & Equip. Co

Plugs, Flush
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks, Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo. (Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Push Buttons
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
Pierson, Roeding & Company
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Manhattan Elec. Supply Co.
San Francisco, 403 Atlas Bldg., 604 Mission St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Moloney Electric Co.
San Francisco, Rialto Bldg.

Nason & Co., R. N.
San Francisco,151 PotreroAve.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 523 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 703 Spaulding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco,MonadnockBldg

Post Co., The Frederick
San Francisco, 135 Second

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
LosAngeles, Union Trust Bldg.

Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill," Pierson, Roeding & Co.
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.
Switches, Push Button
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Tubes and Bushings
Ohio Brass Company

Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Moloney Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Holabird-Reynolds Co.
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee," Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Pierson, Roeding & Company
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758 W. Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas & Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 Pacific Blg.
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco, 682-684 Mission
Wilson Machinery Co.
San Francisco, 161 Market

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General Electric Company

Largest Electrical Manufacturer in the World

General Office: Schenectady, N. Y.

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Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho

3954

This Trade Mark The Guarantee of Excellence on Goods Electrical.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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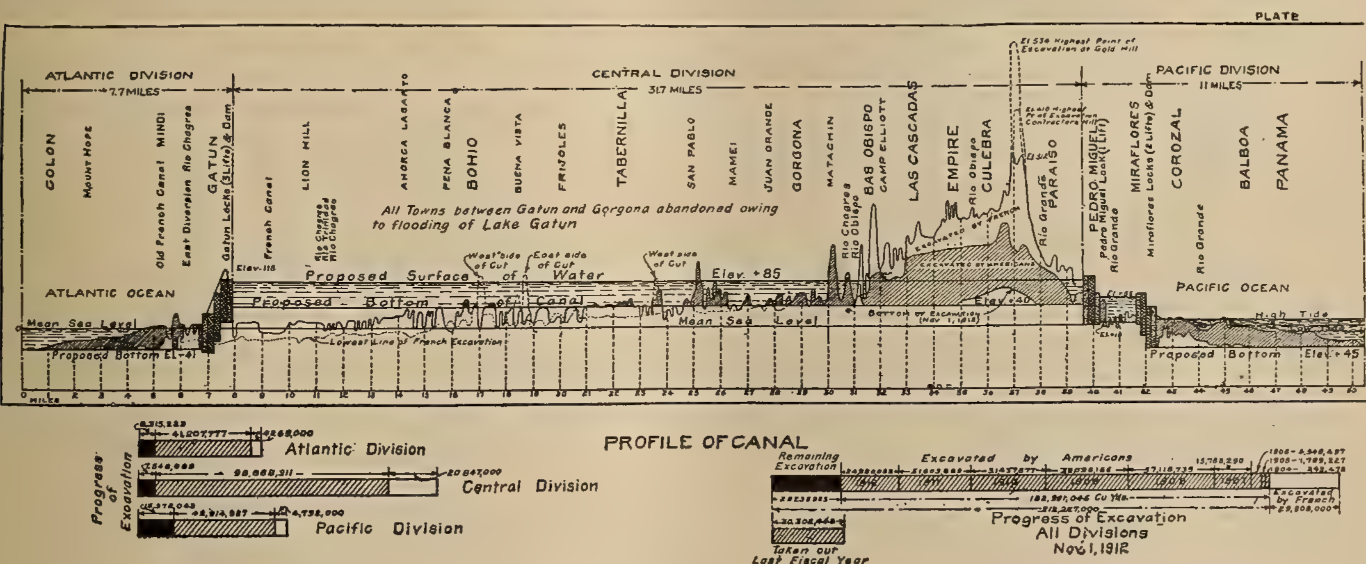
FACTS AND FIGURES ON THE PANAMA CANAL

Today the early completion of the Panama Canal is being confidently looked forward to by literally millions of people the world over. Indeed, it is doubtful if ever in human history an event has been so interestingly and widely discussed by the populace at large or more confidently hailed by them as the ultimate solution of all human wants and ailments.



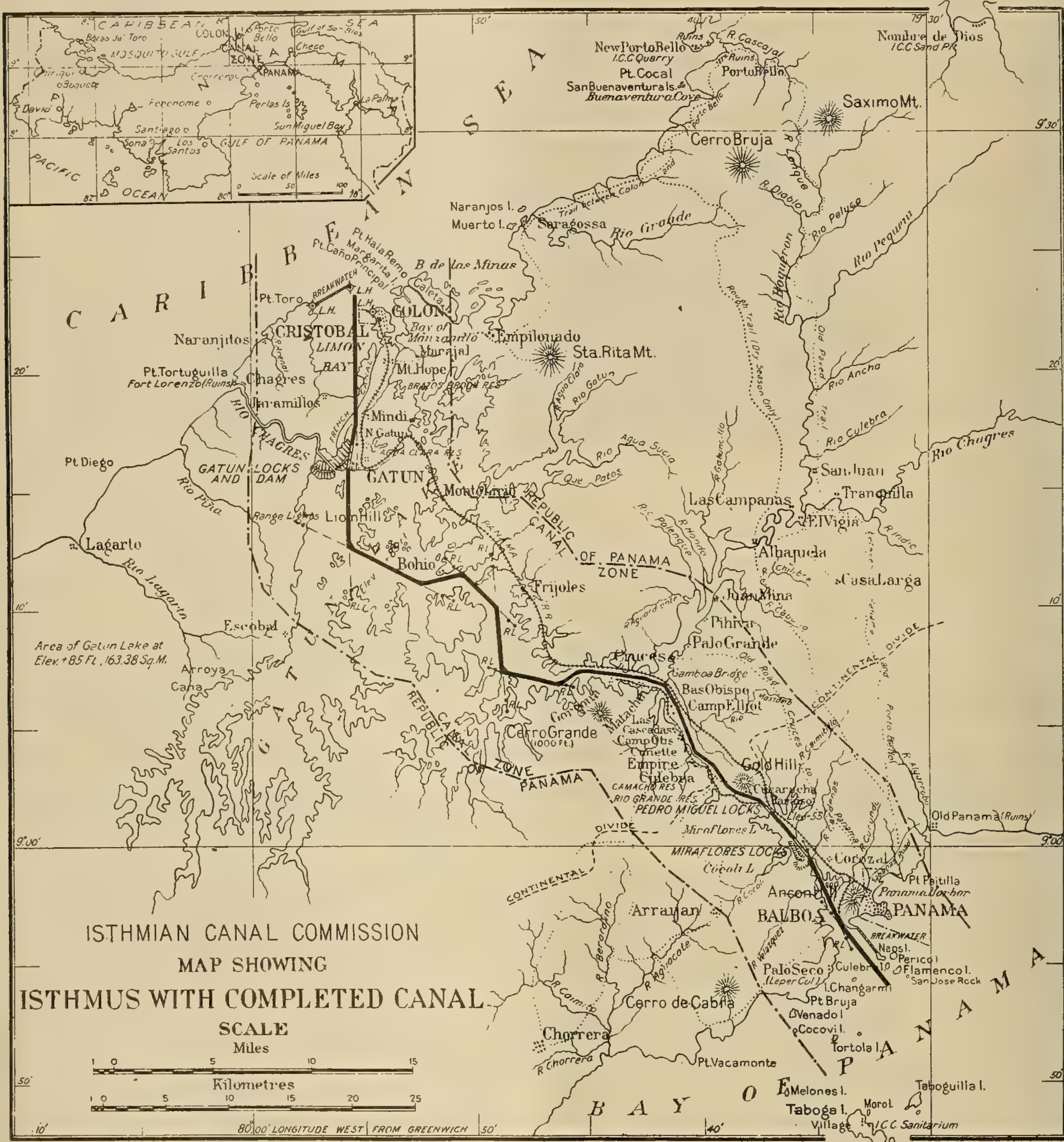
The building of the canal will undoubtedly eventuate in unbalancing the present commercial centers of the world. Westward the course of empire has ever taken her sway. The Pacific Coast as a land for possible commercial aggrandizement has indeed a bright future. There is a demand on all sides for conservative, plain statements of the great work now going on at the isthmus. The following facts and figures, furnished by the secretary of the Isthmian Canal Commission, may be taken as authentic:

The Panama Canal does not, as is quite generally thought, cross the isthmus from east to west. As is shown on the accompanying map, its general direction is from northwest to southeast, the Pacific entrance near Panama being about 22½ miles east of the Atlantic entrance near Colon. It is a lake canal as well as a lock canal, its dominating feature being Gatun Lake a great body of water covering about 164 square miles, and occupying the northern half of that portion of the isthmus through which the canal passes. This lake is an elevated body of water, with a surface level maintained at from 85 to 87 feet above sea level by the Gatun Dam and locks on the Atlantic side, and the Pedro Miguel Locks and dam on the Pacific side. The Culebra Cut is really an arm of the lake. On both Atlantic and Pacific sides there is an approach channel, which is an inlet of the sea, extending from deep water in the sea up to the foot of the locks which lift vessels to the level of the lake through which they are to pass.

The entire length of the canal from deep water in the Atlantic to deep water in the Pacific is about 50 miles. Its length from shore-line to shore-line is about 40 miles. In passing through it from the Atlantic to the Pacific, a vessel will enter the approach channel in Limon Bay, which has a bottom width of 500 feet and extends to Gatun, a distance of about 7 miles. At Gatun it will enter a series of three locks in flight and be lifted 85 feet to the level of Gatun Lake. It may steam at full speed through this lake, in a channel varying from 1000 to 500 feet in width, for a distance of about 24 miles, to Bas Obispo, where it will enter the Culebra Cut. It will pass through

the cut, a distance of about 9 miles, in a channel with a bottom width of 300 feet, to Pedro Miguel. There it will enter a lock and be lowered 30 1-3 feet to a small lake, at an elevation of 54 2-3 feet above sea level, and will pass through this for about 1½ miles to Miraflores. There it will enter two locks in series, and be lowered to sea level, passing out into the Pacific it will be 800 feet, and for 4 miles more, to the northern entrance of Culebra Cut, at Bas Obispo, it will be 500 feet. The depth will vary from 85 to 45 feet. The water level in the cut will be that of the lake, the depth 45 feet.

Three hundred feet is the minimum bottom width of the canal. This width begins about half a mile



through a channel about 8½ miles in length, with a bottom width of 500 feet. The depth of the approach channel on the Atlantic side, where the maximum tidal oscillation is 2½ feet, will be 41 feet at mean tide, and on the Pacific side, where the maximum oscillation is 21 feet, the depth will be 45 feet at mean tide. This mean sea level in both oceans is the same.

Throughout the first 15 miles from Gatun the width of the lake channel will be 1000 feet; then for 4 miles above Pedro Miguel Locks and extends about 8 miles through Culebra Cut, with the exception that at all angles the channel is widened sufficiently to allow a thousand-foot vessel to make the turn. The cut has eight angles, or about one to every mile. The 300-foot widths are only on tangents between the turning basins at the angles. The smallest of these angles is 7 deg. 36 min., and the largest 30 deg.

In the whole canal there are 22 angles, the total

curvature being 600 deg. 51 min. Of thus curvature, 281 deg. 10 min. are measured to the right, going south, and 319 deg. 41 min. to the left. The sharpest curve occurs at Tabernilla, and is 67 deg. 10 min.

Gatun Dam.

The Gatun Dam, which forms Gatun Lake by impounding the waters of the Chagres and its tributaries, is nearly 1½ miles long, measured on its crest, nearly ½ mile wide at its base, about 400 feet wide at the water surface, about 100 feet wide at the top, and its crest will be finished at an elevation of 105 feet above mean sea level, or 20 feet above the normal level of the lake. It is in reality a low ridge uniting the high hills on either side of the lower end of the Chagres Valley, so as to convert the valley into a huge reservoir. Of the total length of the dam, only 500 feet, or one-fifteenth, will be exposed to the maximum water head of 85 to 87 feet. The interior of the dam is formed of a natural mixture of sand and clay, dredged by hydraulic process from pits above and below the dam, and placed between two large masses of rock and miscellaneous material obtained from steam shovel excavation at various points along the canal. The top and upstream slope will be thoroughly riprapped. The entire dam will contain about 21,000,000 cubic yards of material.

Spillway, Gatun Dam.

The spillway is a concrete-lined channel 1200 feet long and 285 feet wide, cut through a hill of rock nearly in the center of the dam, the bottom being 10 feet above sea level at the upstream end and sloping to sea level at the toe. Across the upstream or lake opening of this channel a concrete dam has been built in the form of an arc of a circle, making its length 808 feet, although it closes a channel with a width of only 285 feet. The crest of the dam will be 69 feet above sea level, or 16 feet below the normal level of the lake, which is 85 feet above sea level. On the top of this dam there will be 13 concrete piers, with their tops 115.5 feet above sea level, and between these there will be mounted regulating gates of the Stoney type. Each gate will be of steel sheathing on a framework of girders, and will move up and down on roller trains in niches in the piers. They will be equipped with sealing devices to make them water-tight. Machines for moving the gates are designed to raise or lower them in approximately ten minutes. The highest level to which it is intended to allow the lake to rise is 87 feet above sea level; and it is probable that this level will be maintained continuously during wet seasons. With the lake at that elevation, the regulation gates will permit of a discharge of water greater than the maximum known discharge of the Chagres River during a flood.

Hydroelectric Station at Gatun.

Adjacent to the north wall of the spillway will be located a hydroelectric station, capable of generating through turbines 6000 kilowatts for the operation of the lock machinery, machine shops, drydock, coal-handling plant, batteries, and for the lighting of the locks and zone towns, and, if desirable, the Panama Railroad. The building will be constructed of concrete and steel, and will be of a design suitable for a permanent power house in a tropical country. The dimensions will be such as to permit the installation of three 2000-kilowatt units, and provision will be made for a future extension of three additional similar units. It will be rectangular in shape, and will contain one main operating floor, with a turbine pit and two galleries for electrical equipment. The building, with the machinery and electrical equipment, will be laid out upon the unit principle, each unit consisting of an individual headgate, penstock, governor, exciter, oil switch and control panel.

Water is to be taken from Gatun Lake, the elevation of which will vary with the seasons from 80 to 87 feet above sea level, through a forebay, which will be constructed as an integral part of the curved portion of the north spillway approach wall. From the forebay the water will be carried to the turbines through three steel plate penstocks, each having an average length of 350 feet. The entrances will be closed by cast iron headgates and bar iron trash racks. The headgates will be raised and lowered by individual motors, which will be geared to rising stems attached to the gate castings. The driving machinery and the motors will be housed in a small concrete gatehouse erected upon the forebay wall directly over the gate recesses and trash racks. The gatehouse will be constructed for the present requirements of three headgates and provision will be made for a future addition of three more units.

Water Supply of Gatun Lake.

Gatun Lake will impound the waters of a basin comprising 1320 square miles. When the surface of the water is at 85 feet above sea level, the lake will have an area of about 164 square miles, and will contain about 183 billion cubic feet of water. During eight or nine months of the year the lake will be kept constantly full by the prevailing rains, and consequently a surplus will need to be stored for only three or four months of the dry season. The smallest run-off of water in the basin during the past 22 years, as measured at Gatun, was that of the fiscal year, 1912, which was about 132 billion cubic feet. Previous to that year the smallest run-off of record was 146 billion cubic feet. In 1910 the run-off was 360 billion cubic feet, or a sufficient quantity to fill the lake one and a half times. The low record of 1912 is of interest as showing the effect which a similar dry season, occurring after the opening of the canal, would have upon its capacity for navigation. Assuming that the Gatun Lake was at elevation plus 87 at the beginning of the dry season, on December 1st, and that the hydroelectric plant at the Gatun Spillway was in continuous operation, and that 48 lockages a day were being made, the elevation of the lake would be reduced to its lowest point, plus 79.5, on May 7th, at the close of the dry season, after which it would continuously rise. With the water at plus 79 in Gatun Lake there would be 39 feet of water in Culebra Cut, which would be ample for navigation. The water surface of the lake will be maintained during the rainy season at 87 feet above sea level, making the minimum channel depth in the canal 47 feet. As navigation can be carried on with about 39 feet of water, there will be stored for the dry season surplus over 7 feet of water. Making due allowance for evaporation, seepage, leakage at the gates, and power consumption, this would be ample

for 41 passages daily through the locks, using them at full length, or about 58 lockages a day when partial length is used, as would be usually the case, and when cross filling from one lock to the other through the central wall is employed. This would be a larger number of lockages than would be possible in a single day. The average number of lockages through the Sault Ste. Marie Canal on the American side was 39 per day in the season of navigation of 1910, which was about eight months long. The average number of ships passed was about 1½ per lockage. The freight carried was about 26,000,000 tons. The Suez Canal passed about 12 vessels per day with a total tonnage for the same year of 16,582,000.

The water level of Gatun Lake, extending through the Culebra Cut, will be maintained at the south end by an earth dam connecting the locks at Pedro Miguel with the high ground to the westward, about 1400 feet long, with its crest at an elevation of 105 feet above mean tide. A concrete core wall, containing about 700 cubic yards, will connect the locks with the hills to the eastward; this core wall will rest directly on the rock surface, and is designed to prevent percolation through the earth, the surface of which is above the lake level.

A small lake between the locks at Pedro Miguel and Miraflores will be formed by dams connecting the walls of Miraflores Locks with the high ground on either side. The dam to the westward will be of earth, about 2700 feet long, having its crest about 15 feet above the water in Miraflores Lake. The east dam will be of concrete, containing about 75,000 cubic yards; will be about 500 feet long, and will form a spillway for Miraflores Lake, with crest gates similar to those at the spillway of the Gatun Dam.

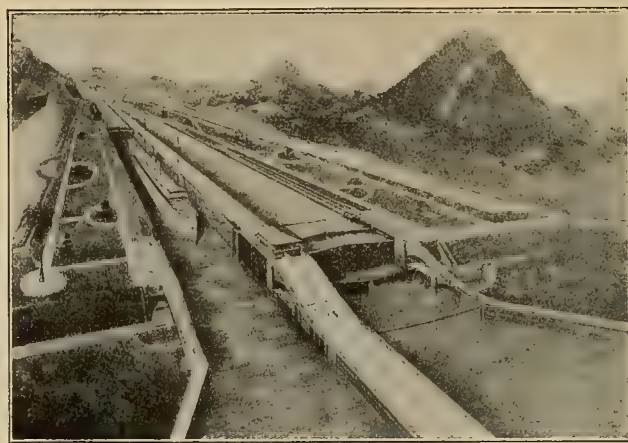
The Locks.

There will be six double locks in the canal; three pairs in flight at Gatun, with a combined lift of 85 feet; one pair at Pedro Miguel, with a lift of 30 1-3 feet, and two pairs at Miraflores, with a combined lift of 54 2-3 feet at mean tide. The usable dimensions of all are the same—a length of 1000 feet, and width of 110 feet. Each lock will be a chamber, with walls and floor of concrete, and mitering gates at each end.

Electric Control of Lock Machinery.

The gates, valves and fender chains of the locks will be operated by electricity, and remotely controlled from a central point; that is, there will be a central control station for each of the series of locks at Gatun, Pedro Miguel and Miraflores. In passing a ship through the locks it will be necessary to open and close the miter gates, weighing from 390 to 730 tons, to fill and empty the lock chambers containing from three and one-half to five million cubic feet of water, to raise and lower fender chains weighing 24,098 pounds each, and to tow the vessel through the locks. All these operations, except that of towing, will be controlled by one man at a switchboard.

A ship to be raised to the lake level will come to a full stop in the forebay of the lower lock, prepared to be towed through one of the duplicate locks by electric towing locomotives. The water in the lower lock chamber will be equalized with the sea level channel, after which the miter gates will be opened, the fender chain lowered and the vessel passed into the first chamber, where the water is at sea level. Then the miter gates will be closed. The rising stem gate valves at the outlet of the main culverts will be closed, while



Typical Lock Scene

those above will be opened, allowing water to flow from an upper level into the lower chamber, which, when filled, will raise the vessel 28½ feet, to the second level. This operation will be repeated in the middle and upper locks until the ship has been raised to the full height of 85 feet above the level of the sea.

The general scheme of lighting and buoying the canal contemplates the use of range lights to establish direction on the longer tangents and of side lights spaced about one mile apart to mark each side of the channel.

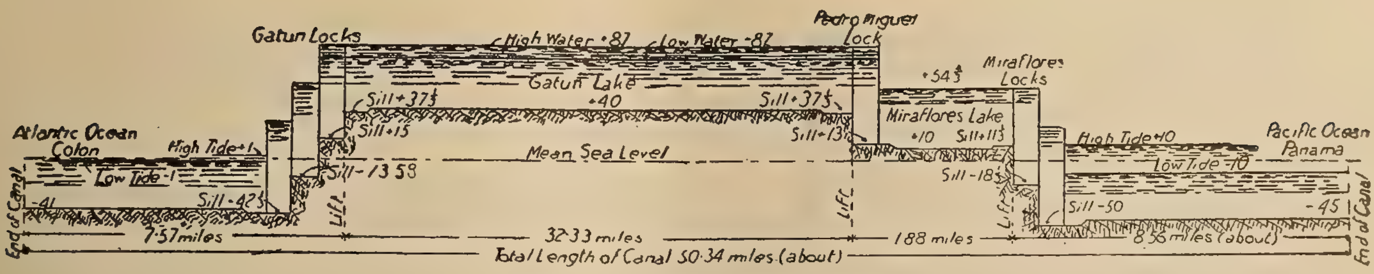
Excavation.

The total excavation, dry and wet, for the canal as originally planned, was estimated at 103,795,000 cubic yards, in addition to the excavation by the French companies. The points of deepest excavation are in Culebra Cut, 495 feet above the bottom of the canal, at Gold Hill, and 364 feet above, at Contractor's Hill, opposite. The widest part of the cut is opposite the town of Culebra, where, owing to the action of slides on both banks, the top width is about half a mile. Records of all excavation to January 1, 1913, are appended. On that date there remained to be excavated in the cut 5,351,419 cubic yards, and in the entire canal proper 23,426,713 cubic yards:

By French companies		78,146,960
French excavation useful to present canal		29,908,000
By Americans:		
Dry excavation	116,428,685	
Dredges	71,851,627	
Total		188,280,312
May 4 to December 31, 1904	243,472	
January 1 to December 31, 1905	1,799,227	
January 1 to December 31, 1906	4,948,497	
January 1 to December 31, 1907	15,765,290	
January 1 to December 31, 1908	37,116,735	
January 1 to December 31, 1909	35,096,166	
January 1 to December 31, 1910	31,437,677	
January 1 to December 31, 1911	31,603,899	
January 1 to December 31, 1912	30,269,349	

Totals by Divisions and Amount to Be Excavated.

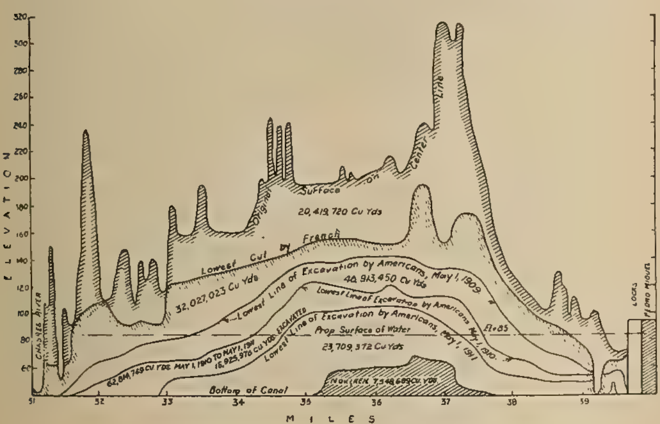
Divisions.	Amount excavated.	Remaining to be excavated.
Atlantic—		
Dry excavation	8,702,997	211,120
Dredges	34,021,280	4,986,380
Central—		
Culebra Cut	88,531,237	5,351,419
All other points	12,384,655	150,000
Pacific—		
Dry excavation	6,998,035	3,312,704
Dredges	37,642,108	10,212,203
Grand total	188,280,312	24,223,826



Profile of Canal and Lock Elevations.

Slides and Breaks.

There have been in all 26 slides and breaks in Culebra Cut; 17 covered areas, varying from 1 to 75 acres, and 9 covered areas of less than 1 acre each, making in all a total of 225 acres. One variety of slide is caused by the slipping of the top layer of clay and earth on a smooth sloping surface of a harder material. The largest slide of this character is that known as Cucaracha, on the east bank of the canal, just south of Gold Hill. This gave the first French company trouble during the final years of its operations. It first gave the Americans trouble in 1905, and between that date and July 1, 1912, nearly 3,000,000 cubic yards of material were removed from the canal because of it. It broke nearly 1900 feet back from the axis of the canal, and covers an area of 47 acres. Another variety of slide, properly called break, is due to the steepness of the slopes and the great pressure of the superincumbent material upon the underlying layers of softer material. The largest slide or break of this type is on the west side of the cut at Culebra, just north of Contractor's Hill, and covers an area of 75 acres. Over 7,000,000 cubic yards of material have been removed from this slide, and it is thought that by the time the canal shall have been completed something like 10,000,000 cubic yards will have been taken out. On the east side of the cut a similar slide covers an area of about 50 acres, breaking back about 1300 feet from the center of the canal. About a half million cubic yards have been taken out of this slide, and more remains to be removed. It is estimated that the total amount of material removed from the canal because of the slides will aggregate between 21,000,000 and 22,000,000 cubic yards.



Profile of Culebra Cut from Dike at Gamboa to Pedro Miguel Locks

Appropriations.

Payment to the New Panama Canal Company	$ 40,000,000.00
Payment to Republic of Panama	10,000,000.00
Appropriation, June 28, 1902	10,000,000.00
Appropriation December 21, 1905	11,000,000.00
Deficiency, February 27, 1906	5,990,786.00
Appropriation, June 30, 1906	25,456,415.08
Appropriation, March 4, 1907	27,161,367.50
Deficiency, February 15, 1908	12,178,900.00
Appropriation, May 27, 1908	29,187,000.00
Deficiency March 4, 1909	5,458,000.00
Appropriation, March 4, 1909	33,638,000.00
Deficiency, February 25, 1910	76,000.00
Appropriation June 25, 1910	37,855,000.00
Appropriation, March 4, 1911	45,560,000.00
Appropriation, August 24, 1912	28,980,000.00
Private Act. Relief of Elizabeth G. Martin	1,200.00
Private Act. Relief of Marcellus Troxell	1,500.00
Private Act. Relief of W. L. Miles	1,704.18
Private Act. Relief of Chas. A. Caswell	1,056.00
Private Act. Relief of Alexandro Comba	500.00
Private Act. Relief of Douglas B. Thompson	1,500.00
Private Act. Relief of Robert S. Gill	2,520.00
Total	$322,551,448.76
Appropriation for fortifications, March 4, 1911	3,000,000.00
Appropriation for fortifications, August 24, 1912	2,806,950.00

Classified Expenditures to November 1, 1912.

Department of construction and engineering	$159,411,558.14
Department of construction of engineering plant	2,868,362.47
Department of sanitation	15,319,682.40
Department of civil administration	5,961,599.68
Department of law	30,887.52
Panama Railroad, second main track	1,123,477.93
Panama Railroad, relocated line	8,866,392.02
Purchase and repair of steamers	2,680,112.01
Zone water works and sewers	5,140,506.45
Zone roadways	1,579,724.67
Loans to Panama Railroad Company	3,247,332.11
Construction and repair of buildings	10,188,813.63
Purchase from New Panama Canal Company	40,000,000.00
Payment to Republic of Panama	10,000,000.00
Miscellaneous	4,207,175.37
Total	$270,625,624.40
Expenditures for fortifications to Nov. 1, 1912	1,685,315.75

OREGON NEW WATER CODE PROVISIONS.

The code, which was drawn up by a committee of experts appointed by former Governor M. E. Hay, is a document of thirty pages.

The code provides four things:

First—A method of ascertaining what water rights exist upon any stream in the state in a definite and final manner and so that a record title to water will be obtained, as is not now possible. At present any appropriator can file upon any amount of water that his fancy dictates. Most streams have recorded filings claiming ten times their capacity.

Second—It provides also a means of regulating the acquistion for new rights, so that the record will in each case be modified where new rights are granted.

Third—It proivides for a satisfactory means for distributing the water among the various ditches upon any stream, so that the rights of all may be protected without recurring legislation; and

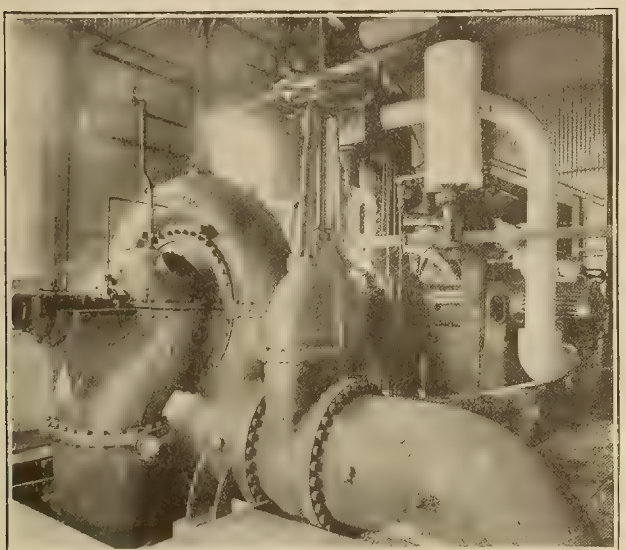
Fourth—The protection of the life and property of the public by a proper supervision of the construction of dams.

ELEMENTS OF STEAM POWER PLANT DESIGN

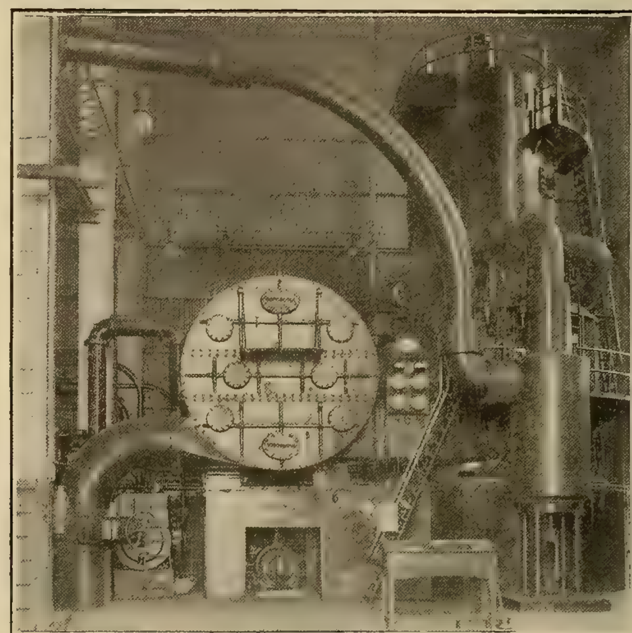
TRANSMISSION OF HEAT THROUGH METAL TUBES. III.

BY C. R. DELANEY.

The question of the size of condensers, feed water heaters, oil heaters, etc., brings us to the consideration of a subject which is of great interest and which has a bearing on steam power plants in a number of different ways; namely, the transmission of heat through metal tubes from a fluid of higher temperature to a fluid of lower temperature. The operation of the steam plant involves first the generation of heat, which is accomplished by burning fuel in a furnace. After this heat is generated it must be conveyed to the engine where it is converted into mechanical energy. If heat itself could be made to travel through a pipe or along a wire from the furnace to the engine in the same manner that steam or electricity is conveyed, our apparatus would be greatly simplified. To convey heat for any distance, however, it is necessary first to heat up some foreign substance such as water or air and then allow this substance to flow the desired distance. The heat in the furnace, therefore, must be taken out of the gases of combustion and passed to the water in the boiler and the steam in the superheater. The steam then carries this heat to the engine and the latter takes up as much heat as it can utilize. The remainder of the heat is either abstracted in the condenser by passing it to the circulating water or it is returned to the boilers. There is therefore, a continual interchange of heat from one fluid to another, and unless the two fluids are mixed together, which is not usually the case, the heat must be made to flow first from the hot fluid into the metal of the tube or vessel containing it, and then from the metal into the colder fluid. It is obvious that if the two fluids are of the same temperature no heat will flow, and this is one of the axioms of heat transmission, namely, that a difference in temperature is necessary for the transmission of heat from one substance to another and the greater the difference in temperature the greater will be the amount of heat transmitted. Just as a difference in pressure causes steam or water to flow through a pipe and a difference in voltage causes an electric current to flow through a wire, so a difference in temperature causes heat to flow through metal and pass from one substance to another.



Centrifugal Circulating Water Pump for Pumping Cooling Water Through the Condenser Tubes.



Separate Condenser for 9000 kw. Curtis Turbine.

The efficiency of a power plant is very largely dependent on the difference in temperature necessary to make heat flow from one substance to another, and the more we can reduce the necessary difference in temperature the better off we shall be. For instance it is usual for the escaping gases to leave a boiler at a temperature 100 degrees or 150 degrees higher than the temperature of the steam in the boiler. If it were possible to bring the temperature of the gases down to within ten or fifteen degrees of the steam temperature, we would save a large portion of the heat that now escapes to the stack. In condensers there is at least 15 degrees difference between the temperature of the condensing steam and the temperature of the outgoing circulating water. If this could be reduced to 1 degree or 2 degrees the vacuum would be materially increased. Similarly in feed water heaters if the heat could be transmitted fast enough to bring the feed water temperature up to within one or two degrees of the exhaust steam temperature a material saving would result.

Transmission of heat is measured by a unit called heat transfer, which is the amount of heat transmitted per hour through one square foot of tube surface for one degree difference between the temperature of the fluid inside and the fluid outside of the tube. Laws governing the transmission of heat are not thoroughly known, although a great many investigators have made experiments with a view to determining them.

It is known, however, that there is a wide discrepancy in the amount of heat transmitted, depending on the fluid under consideration, and it is further known that the amount of heat that can be transmitted will be greatly increased up to certain limits by increasing the velocity of the fluid. It has been found by experiment that the heat transfer in a superheater runs from 3 to 4 B.t.u and the heat transfer in a boiler averages between 6 and 7 B.t.u. The heat transfer from steam in pipes to air in a room runs from 2½ to 3 B.t.u. in the case of bare pipes and from .3 to .5 B.t.u. in the case of well covered pipes. In all of the above cases one of the fluids under consideration is a perfect gas. In the case of transmitting heat from condensing steam or other vapor to water, the heat transfer is very much higher, and it is supposed that this is due to the sudden contraction in volume of the steam causing a high velocity normal to the tube. In the case of condensers, the heat transfer runs from 300 to 500 B.t.u. and in the case of feed water heaters, from 400 to 600 B.t.u., and some manufacturers have secured a heat transfer of 900 B.t.u. by giving the water a spiral motion while flowing through the tubes. Just why there is such a discrepancy between the case of a boiler and the case of a condenser, is not known, but it is of interest to consider that if we could operate boilers with the same heat transfer as occurs in condensers, we could generate 100 times as much steam in a given boiler as we do at the present time.

By means of the known value of heat transfer the manufacturers of condensers and feed water heaters are able to determine how much surface is required for any given condition. Suppose, for instance a condenser has to be designed to suit a 5000 kw. turbine using 5 lb. of steam per kw.-hr. The total amount of steam per hour will be $5000 \times 15 = 75{,}000$ lb. and it is necessary to provide sufficient cooling surface to condense all of this steam at the temperature corresponding to the vacuum desired, which we may assume to be 28½ in. The latent heat of steam at 28½ in. of vacuum is 1040 B.t.u., but as the steam after expanding in the turbine will contain at least 6 per cent of moisture there will be only 94 per cent of 1040 B.t.u. or 977 B.t.u. to be extracted from each lb. of steam. Consequently, the total amount of heat to be abstracted per hour will be $75{,}000 \times 977 = 73{,}275{,}000$ B.t.u. To determine the amount of surface required we must also know the difference between the temperature of the steam and the average temperature of the circulating water. The former is fixed by the vacuum, but the latter will vary with the amount of circulating water and its temperature. We may assume that 10,000 gallons of circulating water will be used per minute and that its initial temperature will be 60 degrees. This water must absorb all of the heat given up by the steam, and in doing so its temperature will rise an amount that can be readily calculated from the quantity of heat and the weight of water, and which we find to be 15 degrees. The final temperature of the circulating water is therefore 75 degrees and its average temperature which may be considered midway between the initial and final temperature is 67½ degrees. The temperature of steam at 28½ in. vacuum is 91.7 degrees, so that the difference in temperature causing the heat to flow from the steam to the circulating water is $91.7° - 67.5° = 24.2°$. Assuming that the heat transfer in the particular type of condenser is 300 B.t.u. per hour per degree difference per sq. ft., then each sq. ft. of surface will absorb $300 \times 24.2 = 7260$ B.t.u. per hour. The total surface required to absorb 73,275,000 B.t.u. per hour will therefore be $\frac{73{,}275{,}000}{7260} = 10{,}100$ sq. ft. For the conditions stated, therefore, about 2 sq. ft of cooling surface are required per kilowatt capacity, and this figure agrees very closely with practice in actual installation. One of the Pacific Gas & Electric Company's 12,000 kw. machines is provided with 25,000 sq. ft. of cooling surface in the condenser. Another machine having a capacity of 15,000 kw. is provided with the same amount of cooling surface. There is, therefore, 2.1 sq. ft. of cooling surface per kw. in the former and 1.66 in the latter.

ARNOLD TRANSPORTATION REPORT.

Owing to the extensive nature of the Arnold investigation and the large amount of material already submitted, the Board of Supervisors has extended an invitation to Mr. Arnold to sum up the results of his investigation thus far prior to the final recommendations. In the absence of Mr. Arnold, the Board was addressed by J. R. Bibbins, his resident engineer, who has been in active charge of the work.

Since the organization of the Arnold transit bureau last year, there have been submitted from time to time to the Board of Supervisors 16 reports, dealing with special subjects preliminary to the final report now in press. In general, these covered tunnels, cars, service, extensions, exposition transit facilities, relief of lower Market street, present and future growth, and Charter amendments. These subjects were briefly reviewed by Mr. Bibbins with the aid of a stereopticon to properly exhibit the numerous analytical diagrams and charts accompanying the report.

Starting with a relief map devoid of streets, the serious deficiencies in street plan and the difficuties of reaching outlying districts were shown to be largely responsible for settlement restricted to nearly one-half of the city, which settled area practically conformed to the 30-minute time zone figured from the business center—Third and Market streets. And although a handicap of 15 to 20 minutes against transbay commuters existed, yet the highly developed electric train service to Alameda County had resulted in the inclusion of Oakland, Berkeley and Alameda in the 5-cent commuter zone, whereas it is impossible to reach even the county line of San Francisco in some cases for the same fare. On the other hand, it was shown by Mr. Bibbins that through the medium of the Twin Peaks tunnel and other rapid transit outlets the 30-minute time zone would be in effect extended to the bench on the west and below the county line on the south for local traffic, and possibly as far as San Mateo for high-speed trains; so that the needs of this city lie largely in the direction of extension of rapid transit facilities rather than lack of patronage.

A careful analysis of growth showed that traction lines are at least six years behind in extensions, and that a construction program should be started immediately involving some 70 miles of single track. These extensions have been carefully planned out by a study of every grade in the city, its relation to location of population and possible transit lines; and a program is mapped out calling for about 15 miles of track per year up to 1920, till the system is caught up with itself, and from 40 to 50 additional cars per year. This program is considered by Mr. Arnold as the minimum necessary for San Francisco to keep pace with its growth.

It is found that the average person of this city contributes perhaps twice as much for transportation as other cities of its class, even exceeding Los Angeles in this respect, and that this contribution ($20 per capita) exceeds that in the form of taxes for defraying the entire running expenses of the municipal government.

Mr. Bibbins showed the very encouraging fact that although San Francisco lost heavily in population as a result of the fire, the subsequent growth has been more rapid than before, and that the city has more than regained its lost ground; and further, that the exodus to trans-bay cities has ceased, so that San Francisco and its surrounding communities from now on will continue rapid growth as a metropolitan district, which for the best interests of the entire community should be united under a metropolitan district control of such matters of common interest as transportation, water, police, etc.

With a present population of nearly half a million for the city and over three-quarters of a million for the entire commuter district, including San Francisco, the predictions made by Mr. Arnold after an accurate analysis of growth indicate that a city of one million inhabitants will have to be provided for within about 30 or possibly 25 years; and about double this population for the total metropolitan district within the same period. This prediction was made to obtain an adequate conception of the necessary investment in transportation facilities which would have to be made either by private or municipal capital, and this investment increases at least three times as fast as the earnings.

The necessity of adequate transportation facilities to the Exposition and the inadequacy of only one or two lines as contemplated were again emphasized by Mr. Bibbins, and in the course of the discussion the Arnold estimates previously made were fully confirmed by Mr. Mortensen, traffic manager of the Exposition, after further study of the situation. If a line is to be built on Van Ness avenue, it was recommended that the rapid transit parking plan proposed by Mr. Arnold should be used, which would provide uninterrupted service during the most congested periods, leaving a 30 ft. roadway on each side, one of which could be reserved for parades and the other for vehicles. Mr. Bibbins laid great emphasis upon the necessity for preserving in all important thoroughfares a freeway for vehicles to pass between cars and other vehicles standing along the curb, and to this end urged the reduction of sidewalk widths and the adoption of the Chicago standard of cars and track centers as exemplified in the new municipal railway equipment, illustrating by photographs the utter impossibility of maintaining service through such a congested street as Polk street without this standard.

In defending the reasonableness of the Arnold estimates for exposition transportation, he showed that the estimated maximum demand of 50,000 persons per hour exceeded the total outbound travel of the entire city from the business district during the evening rush hour, and that the maximum line capacity of 12,000 persons per hour exceeded the present traffic on Market street during the same period.

In discussing the types of cars, Mr. Bibbins pointed out emphatically that the new Geary street cars conformed to the high standard which the city itself imposed upon private transportation companies, combining comfort with reasonable capacity, quick loading and increased power and safety. He pointed out that while the city of Portland limits by ordinance the amount of standing to not over 20 per cent of the seating capacity, the Geary street car can comfortably accommodate double the seating capacity and a maximum of 100 to 110 passengers without interfering with passenger movement; and that the speed of loading is far superior to any cars at present in operation here. By employing a more compact construction, the Chicago standard of car width and track centers could save 18 inches from the roadway, with practically the same aisle space as now available in the McAllister street cars.

In the Arnold recommendations for the improvement of the present United Railroads equipment, it was stated that this loading speed could probably be improved 25 per cent by the suggested modifications in platform arrangement, such as the removal of the bulkheads, straightening of guide railing, and the conversion of the 1300 class cars now operating on Fillmore street into prepayment equipment; also the lengthening of the Powell street cars and abolishing the turntable at Market street was recommended.

An investigation of traffic conditions lasting several months showed that much of the congestion is due to slow loading both along Market street and at the Ferry, and entirely inadequate terminal facilities there; this congestion resulting in uneven headway and erratic loading of cars, although the equipment was generally found to be so well maintained that practically all cars were available for rush hour service. The shortage in cars resulted in such gross overloading on the Market and especially the Mission street lines that as many as 90 passengers were missed by the conductor on a single trip. As a result of these traffic counts, Mr. Arnold found that the 65 new cars on order would hardly have sufficed for proper service as of last July, disregarding the increasing traffic at the rate of about 5 per cent per annum.

For relieving lower Market street Mr. Arnold recommended a plan of tandem stops with two cars crossing intersecting streets together, which has already produced results. Also loading at both ends of the cars, abolition of unnecessary stops, and rearrangement of safety stations so that the present seats at the ends will not obstruct access to the car platform.

The work of the police traffic squad in regulating traffic at crossings is highly commended, as a means of facilitating transit.

As to the ultimate outcome of transit necessities in San Francisco, Mr. Bibbins laid great emphasis upon the fact that unless the city is ready to acquire the present railway properties and build extensions thereto, according to the demand, there is no other way except by the adoption of the Chicago resettlement plan of indeterminate franchise as exemplified in charter amendment 34. This represents a great improvement upon the original Chicago plan in that both intangible and tangible values would be automotically retired by the company; that adequate service would be continuously secured; extensions would be built as required; property would be continuously maintained to the highest standard; and that the city could buy over the property when ready to do so at a far less price than it could organize a new company; or if the city's share in earnings were allowed to accumulate, the entire property would be ultimately recaptured free of cost.

As an illustration of what this plan has done for Chicago, Mr. Bibbins showed comparative results from other cities in the distribution of gross income between company and the public, wherein Chicago receives a larger percentage than any other city and at the same time has laid up a total of about $12,000,000 in 5 years which can be applied to the building of subways. In the final report this resettlement plan will be worked out in actual money values as applied to San Francisco, and shown to be practical for meeting the present conditions as proven by an exhaustive analysis of the financial and operating records of the United Railroads for the last 10 years; and the essential requirements of a general franchise ordinance covering both new and resettlement franchises will be presented in line with the provisions of charter amendment 34 as an enabling act. The city will have specific recommendations as to means of remedying present defects, the exact amount of improvements and extensions of service for both present and future, the legislative machinery necessary to carry out these improvements, and the final results of the recommended plan of settlement projected for the future as far as the term of the franchise grant contemplated.

ELECTRICAL PUMPING AND IRRIGATION

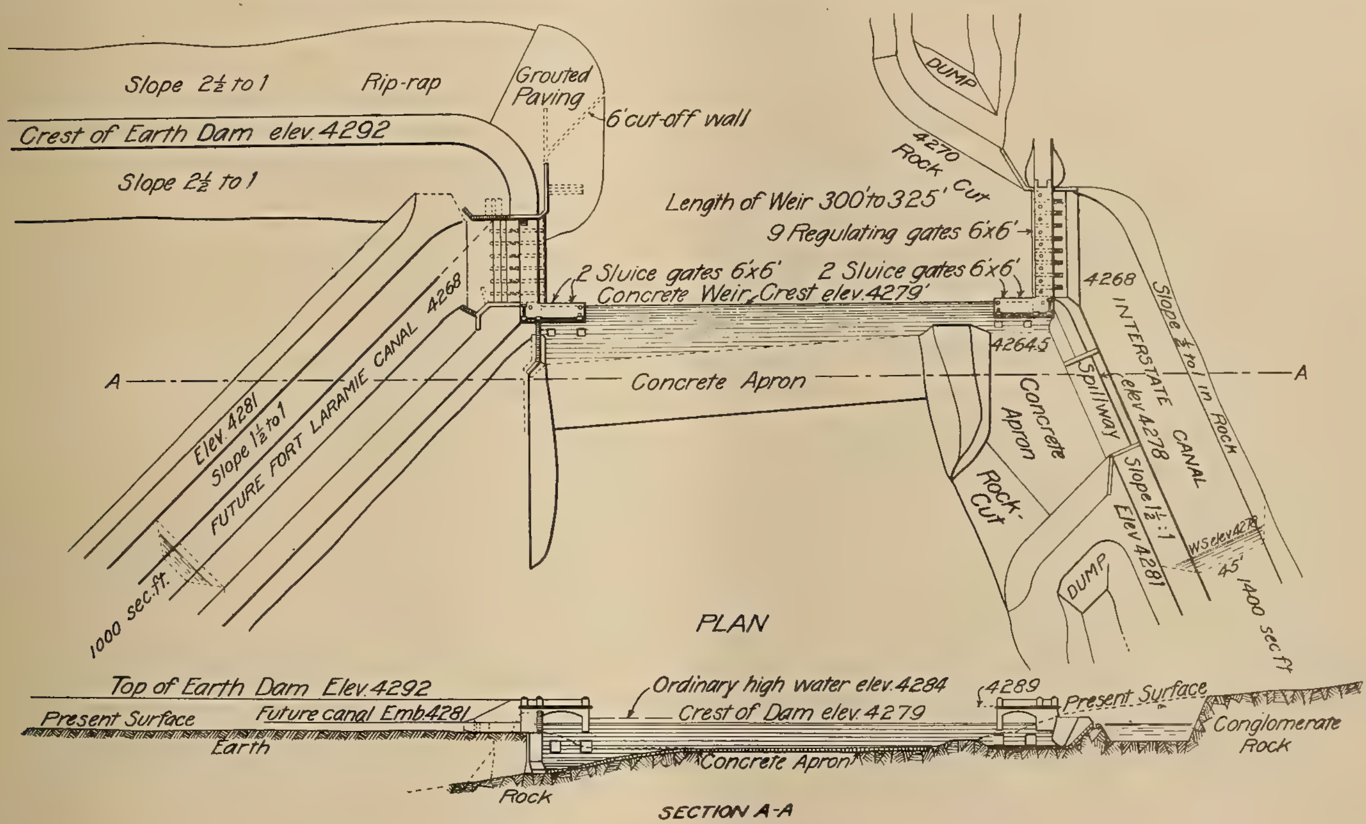
PRINCIPLES OF DESIGN OF HEADGATES.

BY B. A. ETCHEVERRY.

The plans of the headworks of the Truckee-Carson project and of the Yakima-Sunnyside project presented details of design and types of construction different from each other, but illustrate typical forms of construction. While there is no uniform practice in design, there are general principles for different types of construction which are considered in the following paragraphs.

(a) **The overflow wall and basin** above the headgates, previously illustrated by the headworks to Corbett tunnel on Shoshone River, are used when it is desired to skim the surface of sandy or silty streams. The overflow wall is designed to resist the water pressure, and the side walls forming the basin are designed as retaining walls.

(b) **The substructure** consists of the floor on which the piers rest, cut off walls at the upper and lower ends, and in some cases a raised gate sill formed by a low wall extending above the floor between the gate piers. The object of the floor is to act as a foundation to the piers and protect the canal bed from the erosive action of the water passing through the gates. The velocity of the water through the gate will be high when the water level on the upstream side of the gate is high, as during flood times, but the velocity decreases quickly when the water passes into the body of the canal, so that the erosive action will not be serious and will not require a long floor. The length of the floor may be determined by the necessary length of buttresses, and will usually be sufficient, except when built on very porous material, if it extends downstream from the gate openings a distance equal to the maximum height of water above the sill of the gate on the upstream side. When the gates are shut, the upstream pressure tends to overturn the structure about the lower toe. On sandy foundation this action is increased by the upward pressure on the floor, in which case the principles of weir floor design must be followed.



Location of Headgates, North Platte Project, Nebraska-Wyoming.

When concrete or masonry buttresses are used, they must be designed so that the resultant pressure falls in the middle third. When columns are used, they are designed to act as beams with their lower point of support at the floor and the upper point at the operating platform which is designed as a large beam or girder spanning the total width of the gate. This form of construction was used for the head regulator of the diversion works of the Truckee-Carson project on the Truckee River. When frames are used, they may be of wood, steel or reinforced concrete, and the overturning moment must be neutralized. This is partly done by the weight of the structure, which, however, is generally not sufficient.

When the floor is on solid rock, the balance of the overturning moment can be largely overcome by securing a good bond between the floor and the foundation. For a concrete floor the adhesion between the concrete and the rock will have considerable re-

sistance. For a wooden floor the bond is obtained by means of drift bolts. In addition, the floor can be extended upstream above the gate a sufficient length to produce a counter moment due to the weight of water equal to the balance of the overturning moment.

When the floor is on soil or sand, no bond can be obtained, and it is necessary to depend on the counter moment of the weight of the superstructure and floor and the weight of water on the upstream floor extension to balance the overturning moment of the water pressure on the face of the gates and piers and of the upward pressure on the underside of the floor. The minimum length of upstream floor extension may be determined by the upstream extension of the concrete buttresses, usually of at least 2 ft., in order to form the nose of the buttress and the grooves for the gates.

When there is an upward pressure on the floor, due to the underflow, this pressure is diminished by using cut off aprons or sheet piling at the upstream toe. The thickness to be given to the floor will depend on the depth of sheet piling or apron. The upstream cut off wall usually extends to a depth equal to one or two times the maximum depth of water above it; the downstream cut off wall extends below the bed of the canal a distance equal to the depth of water in the canal. The upper cut off wall obstructs the underflow, and with the lower one confines the sand. The lower cut off wall also prevents undermining at the lower end. The floor between the two aprons may require reinforcement to resist the upward pressure.

(c) Wing walls and side walls. The inlet wing walls generally consist of the training walls proper and the cut off wings. The training walls are usually in the same vertical plane as the gates, parallel to the bank of the river, and extend upstream and downstream from the gates a sufficient length to form one side of the sluiceway and to protect the bank of the river. The cut off wings are intended to prevent the water from eroding the bank at the ends of the wing walls and washing around the structure. The cut off wings usually extend from the end of the wing walls into the bank a length equal to from ½ to 1 times the maximum depth of water in the stream. The cut off wings are sometimes replaced by riprap or paving.

The side walls with the floor form the channel of the regulator. They resist the earth pressure and hold up the banks on both sides of the channel. The outlet wing walls extend downstream from the end of the side walls and are used to make the transition from the rectangular channel of the regulator to the trapezoidal canal section. They may be vertical wings placed on an angle to the canal axis so as to extend into the banks of the canal, or may be warped surfaces.

(d) **Buttresses, columns, or frames** with grooves into which the gates are placed. Buttresses are either masonry, concrete or reinforced concrete. Masonry or concrete buttresses are designed as gravity walls, so as to produce no tension in the concrete; this is obtained when the resultant of the water pressure and the weight of the buttress fall within the middle third. These buttresses are trapezoidal walls extending from the floor to the operating platform which is supported on them. The top length of the walls will be the width of the operating floor, usually from 4 to 5 ft. The thickness is generally about 3/10 the width of the opening and the length at the floor line must be sufficient for the resultant pressure to fall within the middle third. Reinforced concrete buttresses and frames of wood or steel must be rigidly connected to the floor to prevent overturning. Reinforced concrete buttresses are made 12 in. or less in thickness with sufficient reinforcement extending from the buttress into the floor to obtain a good bond. The buttress is designed as a cantilever fixed at the floor. The top of the buttress supports the operating platform. A frame of wood or steel consists of a vertical post with one or more inclined supports extending from the post to the floor, with additional bracing where necessary. The operating platform is supported on a frame fastened on the upper part of the post. The post is built up to form grooves for the gate, and must be connected to the floor. The post is designed as a beam fixed at the supports and braces are designed as columns.

When columns are used to separate the gate openings, the columns are designed as beams with the floor for their lower point of support and the operating platform for the upper point. The operating platform which spans between side walls is designed as a beam or girder. Grooves for the gates are formed in the columns. This form of headgate, on account of the large stresses transmitted to the operating floor, is only used when the span between side walls is not too great.

The grooves in concrete are usually formed by channels imbedded in the concrete. These channels may be specially made with projections to give good anchorage or ordinary channels may be used anchored by means of bolts.

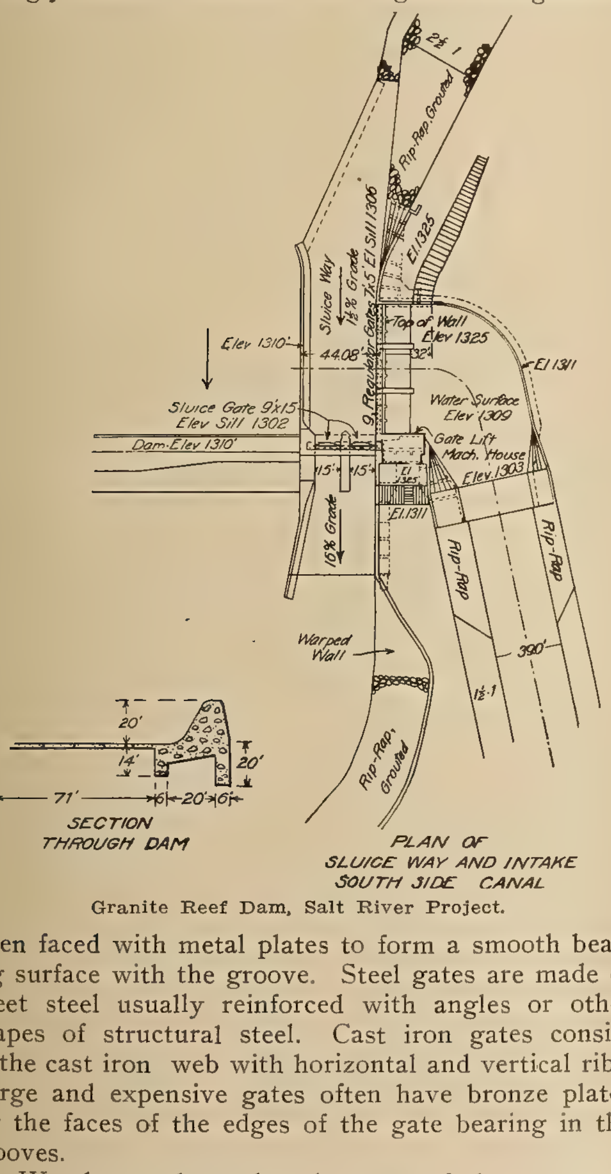
The grooves for metal posts are usually formed from a combination of angles or other structural shapes. For wooden posts the grooves may be formed by using posts built up of several pieces.

It is a common practice to provide in concrete buttresses two sets of grooves, the upper set being for flashboards to be used in case of emergency. These grooves need not be lined with metal. Concrete columns are generally rounded on the inlet edge. Concrete buttresses are produced upstream from the gate openings a distance of at least 2 ft. This is desirable to form a rounded nose and to provide flashboard grooves. The nose can be made either semi-circular or by two arcs described with a radius equal to the thickness of the pier.

(e) **Panel walls** to close the opening between the buttresses above the gate opening. The top of the gate opening is generally slightly lower than either the crest of the dam or the low water level of the river. The operating platform and top of the structure must be placed above high water level. The space between the buttresses and extending from the top of the gate opening to high water level is closed by a panel wall which prevents the overtopping of the gates. This wall can be made of wood, steel or reinforced concrete and is designed as a slab whose span is equal to the distance between supports. In

some cases where the flood water level is not high the gates extend sufficiently above the crest of the weir to prevent overtopping; this, however, increases the pressure on the gates and is generally not desirable.

(f) **Gates.** The gates may be classified according to the material used in their construction, the form of the gate, and the method of operation. The materials commonly used are wood, steel and cast iron. Wood gates are generally made of two thicknesses of planks, one horizontal and one vertical, and braces extending either vertically or diagonally from the top to the bottom of the gate, to which the planks are strongly nailed or bolted. The edges of the gate are



Granite Reef Dam, Salt River Project.

often faced with metal plates to form a smooth bearing surface with the groove. Steel gates are made of sheet steel usually reinforced with angles or other shapes of structural steel. Cast iron gates consist of the cast iron web with horizontal and vertical ribs. Large and expensive gates often have bronze plates for the faces of the edges of the gate bearing in the grooves.

Wood gates have the advantage of cheapness and ease of construction, but are not durable. Steel gates are usually cheaper than cast iron gates, but are not so durable.

The most common form of gate is the vertical rectangular gate, to which the above descriptions apply. The other types of gate used in practice are flashboards, needles, and Taintor gates. Flashboards are planks 6 in. to 8 in. wide, placed horizontally in the grooves one at a time and removed by means of hooks. Needles are vertical flashboards placed with one end on the floor and the other supported on a horizontal beam or platform. Flashboards and needles are inconvenient to operate and not water tight, and do not give close regulation. They are seldom used at the headgates of modern systems; the only advantage of flashboards is that the water passes over them and this permits skimming the top of the water of streams carrying much silt or sand. Provision for flashboards or needles is often made above the regular gates to permit their use in case of emergency. Taintor gates consist of a circular surface or shell revolving around a horizontal shaft to which it is connected by means of braces and radial arms. The upstream face is convex to the water surface; the water pressure is transmitted to the pivoting shaft and the line of resultant water pressure always passes through this shaft, so that there is no tendency for the gate to turn either up or down. The only forces to be overcome to lift the gate are weight, the friction of the pivoting axle, and the friction caused by the pressure of the rubber belting or staunching material, fastened to the circular edges of the gate, on the sides of the buttresses. The radius of the gate is usually taken about 1.5 times the height of opening and the axle is placed at a height above the floor equal to the height of opening. This type of gate has the advantage that it requires a small lifting force and can be used for wide openings, but there are difficulties in construction and installation and operation which may be objectionable. The main objection is the leakage. This can be prevented satisfactorily at the sides between the edges of the gate and the buttresses, but it is more difficult to prevent it at the top between the edge of the panel wall and the surface of the gate. A serious objection in operation is that when the water carries considerable drift material, the drift may lodge against the gate and wedge itself between the gate and the lower edge of the panel wall

The usual method of operating a gate is to raise it sufficiently to give the required discharge through the opening. With streams carrying considerable silt or sand it is desirable to skim the surface water. This requires a different method of operation. It is usually done by passing the water over the crest of the gate between the lower edge of the panel wall and the top of the gate. The area of the opening is regulated by the gate and is increased by lowering the gate. Other means of skimming the surface water are either the use of flashboards or the use of gates built in two or more sections operated independently. Each section has its own set of grooves and its own lifting device. To open the gate the top section is first lifted and the water passes over the crest of the second section. If a larger volume is desired, each section is raised in turn.

(g) The **operating platform** is usually 4 to 5 ft. wide and is supported on the top of the buttresses or frames. It is usually designed as a slab or beam made of reinforced concrete or wood. When made of masonry or plain concrete, it consists of a series of arches between the piers. It must be designed to resist the bending moment of the force required to either open or close the gate. Unless the provision is made in the design of the buttress and grooves for the installation of the gates, it is necessary to leave a narrow opening in the operating platform in line with and above the grooves through which the gates can be lowered into position.

WHAT IS AN ENGINEER?

BY E. N. PERCY.

Of the four leading professions practiced in the civilized world, namely—Ministry, Law, Medicine and Engineering, the latter has the least standing today, although the nobility of its calling ranks favorably with that of any of the other professions. This lack of respected eminence is due to several causes, having their origin in the ancient custom of despising the man who works with his hands. The immediate and most important reason existing at the present time is the fact that while a member of the clergy must prove himself worthy and obtain certain licenses and diplomas, a member of the legal profession must establish himself before the bar and a Doctor of Medicine must be licensed by his government before they can practice their respective professions, an engineer is free to represent himself as such to the public regardless of his training.

The training of the three great professions just mentioned must be both academic and practical before they are permitted to practice.

The word "Engineer" is generally used today as a misnomer, conveying no information whatever.

Jones & Smith, who a few years ago were respectable and prosperous tinsmiths, have blossomed out as ventilating engineers without any known addition to their previous engineering knowledge acquired in the tin shop.

Mr. X., who for many years conducted a reliable draftsman and blue-print business, has announced himself as a civil engineer, despite the fact that the extent of his out-door experience has been an annual vacation of two weeks.

Fred Jones, who was chief engineer of the Cosmopolitan Life Insurance Building for the last fifteen years, has taken up consulting engineering notwithstanding that he has never designed an engine and could not do so if he wished, and has never built one.

Professor Z. of the Baptist College of Engineering, who elucidates equations for the benefit of embryo engineers, has opened consulting engineering offices in spite of the fact that he could not tell a file from a drill, and had never had a pair of calipers in his hands.

The truth of the matter is, in the writer's opinion, that a true engineer, whether civil, mechanical, electrical or of some other branch of industry, is a man trained practically and academically in all the branches of his specialty, and thoroughly qualified thereby to perceive the particular type of design required for his problem, to make that design, to personally supervise the construction in accordance with that design, instructing less expert workmen how to perform their tasks with the tools necessary, to assemble the elements of this design into an entirety and finally with his own hands or under his experienced supervision place the entirety in operation and operate the same to the satisfaction of all concerned.

If a man is able to perform one branch only of these various phases of engineering he is not an engineer, but a specialist of limited capacity, of limited opportunity or limited experience, it being conceded that it takes an exceptional man to make a good engineer just as it takes an exceptional man to make a good minister, lawyer or doctor. He must have the character and perseverance to properly serve his time practically and academically at his profession. He must have the memory, reasoning power and initiative necessary to the great work of creation, execution and operation incidental to engineering problems.

If a man is skilled in shop work only he is not an engineer but a mechanic, artisan or fitter and may well be proud of his calling provided he can do his work well.

If a man is skilled in draftsmanship he is not an engineer, but a draftsman. A draftsman should have a technical education, but this by no means makes him an engineer since his judgment is comparatively worthless outside of the realm of equations, curves and academic data. For instance, in the design of concrete, cast iron, piping and many other branches of engineering, academic education plays a comparatively small part, the designer being absolutely dependent upon his judgment which in turn is the fruit of actual experience with these materials and can be derived in no other reliable manner. Therefore, the academic draftsman, no matter what his education, is not a reliable designer. On the other hand neither can the draftsman who has served his time in the shop and the foundry or the steel works, but is practically without technical education, be a reliable designer for the reason that a great deal of work, such as the proportioning of fitted parts, design of structural steel, prospective pressures, stresses, etc., can only be arrived at through the medium of technical work. Such a man is not a reliable designer excepting under circumstances in which his work will be confined to detailing or copying the designs of others with such minor alterations as lie within the scope of his personal experience.

The proper training of an engineer is a problem which each man should solve for himself and in doing so should seek the advice of disinterested parties for the reason that experience and education in the various branches of his chosen profession are acquired from institutions which have in every case a view point of their own. A university with its renowned teachers, its laboratories, its super-scientific methods of approaching all problems, its horror of empirical methods, while offering what is probably the best possible mental discipline that a young man can have, holds the future engineers' ideas along channels that are a little narrow when in the commercial world. To illustrate this point—it is the experience of practically every technical student to learn the last possible word in the design of machinery or structures for economy of operation. His first experience in the industrial world is to learn that in the vast majority of cases economy of operation is a minor consideration and initial investment a very big consideration. Furthermore he learns that the power plant, to which he has devoted so many years of study, is a minor part of, for instance, a shoe factory, and the shoe machine, about which he never learned anything, he is asked to improve and simplify, in order to increase production.

It is not the purpose of this article to criticise any

institution and last of all our sources of learning, but merely to make certain statements in the endeavor to define an engineer. The only way to obtain practical experience is to apprentice one's self in a shop or on a pile driver or in an electrical plant or with a gang of laborers according to the branch of the profession in which a man may engage. With the apprentice system it is an unfortunate fact that the seeker for information and experience must suffer from economic conditions, that is to say, employers use apprentices not for the purpose of educating them for the shop, but as a means to obtain cheap labor, and in most shops an apprentice will be paid as little as it is possible to obtain an apprentice for, and they are usually kept on one task as long as possible with a view to increasing their production. Their experience on one task is entirely out of proportion to the time necessary for obtaining a knowledge of the same. This is particularly so with young men whose minds have been thoroughly trained and who tend to grasp the details of practical experience more quickly than the untrained apprentices. It is a well known fact that a bright apprentice with from one year to two years' experience can leave and get a position at another shop for three or four dollars a day and thereby prove that he is worth that amount of money to his original employer. It is also a well-known fact that the shop which trains an apprentice will never pay him as much upon the completion of his apprenticeship as will another shop. At the same time they will take in an outside apprentice for more money. This is based purely and simply upon the idea that "a prophet hath no honor in his own country."

Therefore, cannot the various engineering societies determine upon a standard which shall define the engineer as a man who is trained in all branches of his profession, requiring that other members of the engineering society shall be known in accordance with their training as technical experts, artisans or fitters, operators, constructors, and honored as such in their respective branches, and to be known by two or three names as they progress from one department to another; that is to say, draftsman and machinist, mechanician and operator, tinsmith and ventilating mechanic. Reserve the honored term of engineer for those who are engineers and can, as stated above, conceive a design suited to a condition, make that design, build the structure to that design and place it in operation. Can not engineers work together to have this status recognized and legalized by the federal government with proper penalties for misuse of the term, making the engineer a man who is respected by every member in every branch of his profession because he is equally skillful with any of them.

Irrespective of training there is another element which will enter into the success of an engineer. A man may be trained in both the practical and academic branches of his profession, and yet fail as an engineer because he lacks the power of coordination, the ability for logical reasoning or the ability to find in his education the soil for ideas and initiative. No man can be a great engineer who is not a born executive and a leader of men, since the first duty of a constructing engineer is to handle men, that being incidental to the execution of all other work.

It is a common expression in this day and age to hear that young engineers are a "drug on the market," and it is the truth with this qualification; they are not engineers. The shops are graduating men every day who call themselves engineers when they are in reality machinists, unable to operate a large power plant. One of the finest training schools in the world, namely the Merchant Marine, is yearly licensing through the federal government competent young men as engineers, who are perfectly qualified to operate large power plants and in most cases are able to build them because of the necessary previous training in a shop, but are utterly incapable of designing same, forecasting results or even of analyzing sources of loss in engines. Such men are to be honored in their profession as skilled and licensed operators, but it is not proper to call them engineers any more than we would call a nurse or a skilled hospital attendant a doctor.

As engineering is practiced today in its higher branches, a brilliant academic man will as a rule co-operate with a brilliant practical man to bring about a desired result, neither one of whom could go ahead alone; but it frequently happens that one is acting for the buyer and the other for the seller, and it is only human that personal jealousies shall arise between men so differently trained, neither of whom is willing to concede, as a rule, that he lacks the particular training which has been the lot of his colleague, and it would be much better if one man had the complete training.

The greatest argument for the ideas set forth in this article is the fact that there is little or no remuneration for the practicing engineer. This is because of the fact that most manufactured products and machinery are highly standardized and it is only necessary for a firm to employ a designer at a comparatively small salary whose principal business is to collaborate the data in catalogues of manufacturers so as to rear a structure such as his employer desires. Such details as he may not be familiar with are provided in turn by the engineer of the manufacturer, who also works at a fairly small salary since he has concentrated his efforts on a specialty; a knowledge of which could be acquired by another equally cheap man should it be necessary. What then is the field, if any, for an engineer?

There is none for a man who desires to be taken care of, the man who wants a comfortable nest to work in while someone pays him a fat salary. However, engineers should have legal protection by licensing and a legal definition of what constitutes an engineer. Furthermore if given this legal protection they can make themselves necessary to civilzation since of the four great professions the engineer is the only one who is a producer.

A great business man has said that the greatest risk in business and government is our dependence upon lawyers and as for ministers and churches each person has his private opinion. No such opprobium can ever be cast upon the engineer for he is a producer and creator, ever rearing structures for the good of civilization and as monuments to his own skill.

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Entry changed to "The Journal of Electricity," September, 1895
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1890.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

International Engineering Congresses

Facts and figures on the near completion of the Panama canal, appearing on another page of this issue, forcefully remind all of the early approach of the international engineering congresses to be held on the coast in 1915. Experience gleaned from former undertakings of this nature too strongly emphasize the necessity of early notification and preparation by those who are to contribute papers to such distinguished and learned gatherings.

The busy sound of the pile driver and the crack of the grader's whip at the exposition grounds indicate to the onlooker that no chances are being taken by the authorities in charge to delay in any manner the operation of the published schedule. Indeed, from comparison with progress books of other international fairs the Panama-Pacific has at present a margin of lead well worthy of congratulation.

The engineers of the coast have oversubscribed the ten-thousand-dollar guarantee asked for by the national engineering societies. These societies themselves, with but a single exception, have generously pledged their financial support. To make preliminary action complete, word is hourly awaited from the American Institute of Mining Engineers. It is rather surprising that an organization having such vast interests at stake and which must perforce profit by the holding of an international congress in a land of tremendous natural mineral wealth should be the impedance factor in getting actual progress effected.

The affairs of the International Electrical Congress meanwhile are rapidly formulating themselves. Thus far the following tentative dates have been set for these world gatherings:

Sept. 6, 1915, International Electrotechnical Commission.
Sept. 13, 1915, International Electrical Congress.
Sept. 20, 1915, General Engineering Congress.
Sept. 27, 1915, International Gas Congress.
Sept. 27, 1915. International Electric Light Association.
Oct. 4, 1915, American Electrical Railway Association.

The leaders of this movement have used considerable foresight and discretion in planning the dates as indicated, thereby heading off possibilities of conflict. Other allied and affiliated organizations are looking westward for their 1915 gatherings. It would seem, then, that much early planning is imperative for synchronous operation on the part of all who thus contemplate convening near the waters of the Golden Gate in that year of years—1915.

What Western Water Power Really Means

Western men look with joy and favor upon the recent defeat of the Connecticut River dam bill by a substantial majority in the Senate of the United States. This bill contained a provision imposing an annual federal tax upon the developed water power of this river. Should it have carried an opening wedge would thus have been given to a system under which all water powers hereafter developed in any of the states should be placed under federal control and regulation, and thus would those developing needed water powers of the West be compelled to pay special taxes into the federal treasury to add to the cost of water power to be paid for by the users of such energies.

A federal tax upon water powers is no more equitable than a federal tax upon the power developed from coal or gasoline, or a federal tax upon the wind that drives the Dutch windmill. A prominent hydroelectric power company of the Northwest justly and reasonably boasts of its annual accomplishments in the following comparative figures:

During the year ending September, 1912, this company generated energy equivalent to 365,500,000 horsepower hours.

As 3.64 lb. of coal are required to generate one horsepower hour, the coal equivalent of the waterpower energy generated during the year is 650,000 short tons.

The average value of Washington coal at the mine, last year, according to United States Geological Survey figures, was $2.29 per ton. If freight at 50 cents per ton is added, the saving effected by water power generation in a single year amounted to $1,825,000.

You have all read theoretical articles on conservation, but this is one of the few you have read in which conservation results to you and posterity, and in which has been expressed figures showing its actual money equivalent.

Power developed from water utilizes that which is at present going to waste and yet which constantly replenishes itself. Scientists, following the rapid consumption of coal and other fuels, have meted out in definite years ahead a period where a scarcity of such materials may be expected, due to exhaustion of the natural supply. No human being has as yet, however, dared to name the date in the far distant future when the Almighty, in his wisdom and foresight, will cease to supply the water-fall with its blessings for mankind.

Those favoring the federal tax on water powers proclaim their sincerity under the sacred banner of conservation. According to the Standard Dictionary "to conserve" means "to keep from loss, decay or injury." Any natural resource, properly harnessed, that year in, year out, generation after generation without loss, decay or injury pours its rainbow blessings upon mankind certainly needs not the loud protesting political conservationist to dwarf the growth of a Western Empire by imposing a tax upon its natural heritage.

The Dignity of Organization

To increase the use of electric power and appliances, many and varied organizations are today contributing untold effort. Results, too, are being accomplished on all sides. Summing up the entire momentum thus generated it is doubtful if the world has ever witnessed such strenuous aggrandizement brought about by the harmonious workings of every phase and branch of an industry. The learned engineering society, the national gathering of electric light and power men, the development league, the commercial organization and even the fraternal order have been invoked to synchronously pull together for everything electrical.

The unprecedented growth in the electrical industry that has thus resulted is indeed a forceful lesson in results to be accomplished by co-operation. Many of these great organizations brought to life under the thumping pulse of enthusiasm, without regard for permanency, are today preparing to build on a more stable basis—a basis that will prove lasting in perpetuating the ideals of its founders. Like the ties of human life, to be permanent the underlying bonds of sympathy and regard in any organization must be forged so strong and of such mutual unselfed interest that when the glimmer and glitter of first meeting die away, the real solid cement of co-operation is sure to wield the destiny of such a union.

We are all weary pilgrims in search of better and enlarged opportunities. Organization by fraternal affiliation suggests possibilities not to be embraced under any other scheme of human binding. Here may be found a common meeting place for engineer and contractor for central station manager and isolated plant operator, for jobber and consumer. All feel an inherent thrill when the future of the electrical industry is discussed. All in a united effort may conquer every obstacle.

To be true and to be loyal are two of the highest attributes. They represent a living fire which has thrilled men in all ages. The destinies of nations and rulers are sealed according to the truth and loyalty pervading not alone the rulers in the chambers of legislation, but throughout the rank and file.

Any institution, then, that imbues its members with truth and loyalty will live forever. Truth and loyalty are aroused in the human breast in solemn minutes of reflection. Dignity, hence, is an absolute necessity in a ritual or proceeding of any sort designed to permanently hold men in a great cause. In the furthering of electrical organization, permanency is thus to be attained.

Electrically Operated Farm Vehicles

Something over two years ago the whole world was interested and its admiration aroused in the great walk of John Weston from Maine to California. How insignificant, on the other hand, do we look upon the feat performed in ploughing five sections or square miles of soil! Yet, when the farmer ploughs such a tract of land by single furrow, Weston's feat necessarily fades into insignificance in comparison. Indeed, a trip of 25,000 miles, or, in other words, a journey over land and sea around the world is thereby equalled in distance traveled.

It is surprising to note the rapid strides being now made in simplifying farm life. Electrically propelled vehicles play no small part in this evolution. The plough, the thresher, the grain elevator and the truck, all electrically operated, vastly aid in this new life on the farm. The trend of the times is toward cheaper power and lower cost of appliances. At first the electrically operated farm devices were recognized as mere luxurious playthings with which the wealthy alone could afford to experiment. In our last week's issue, however, may be found carefully compiled data wherein is shown the superiority of the electrically propelled vehicle over horse and gasoline for practically every type of truck. The farmer has, as a rule, little patience with luxuries that do not aid in reducing costs per acre of produce or else extending the upper limit by putting upon the market a higher priced seller. The rapid innovation now seen throughout the West of electrically propelled vehicles upon the farm indicates not that the farmer is giving himself over to high and extravagant living but that the earning capacity of his tract of land is being by its uses materially advanced.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

R. D. Holabird of the Holabird-Reynolds Company is at Los Angeles.

J. G. Pomeroy has joined the Illinois Electric Company at Los Angeles.

J. B. Francis has given up his interest in the K. P. F. Electric Company and is now at Auburn, Cal.

Robert Kuhn, secretary of the American Electrical Heater Company of Detroit, Mich., is at Los Angeles.

Munson Burton, newly appointed Pacific Coast manager of the Westinghouse Lamp Company, is at San Francisco.

A. L. Leeper, designing engineer for the tower department of the American Bridge Company, is at San Francisco.

W. Brewster Hall, Pacific Coast manager for Pass & Seymour, has returned to San Francisco from an extended trip East.

George R. Murphy, sales engineer with Pierson, Roeding & Company, has returned to San Francisco from Salt Lake City.

John A. Britton and **E. C. Jones** are delivering an interesting series of lectures on gas engineering at the University of California.

James Strachan, formerly with L. B. Stillwell at New York City, has joined the engineering staff of F. G. Baum & Company at San Francisco.

P. J. Aaron has resigned as manager of the Seattle house of the Western Electric Company to assume like duties for the Fobes Supply Company.

Carl M. Will, formerly assistant manager for the Fobes Supply Company at Seattle, is now in charge of the company's Portland sales office.

F. W. Stearns, one of the vice-presidents of the Western States Gas & Electric Company, with headquarters at Chicago, is visiting the Pacific Coast.

W. W. Briggs, general agent for the Great Western Power Company, is making an inspection of the company's system including the power house at Great Bend.

J. W. White has resigned as chief engineer of the Vix Engineering Company to rejoin the Fort Wayne Electric Works as sales engineer at San Francisco.

E. O. Sessions has retired as a member of the firm of Woodmansee, Davidson & Sessions, consulting engineers, Chicago, Ill., and will announce his plans in the near future.

O. S. Coldwell, recently of the New York office of the Western Electric Company, has been made manager of the Seattle branch; **N. D. Brainerd** has been appointed sales manager.

Chas. T. Philips, consulting electrical engineer at San Francisco, gave a lecture on lighting systems at a meeting of the Civic League of Improvement Clubs at San Francisco on February 28th.

W. L. Huber has resigned from the position of district engineer of the fifth district of the United States Forest Service to engage in a general practice of civil engineering with offices in the Foxcroft Building, San Francisco.

B. E. Salisbury, vice-president, treasurer and general manager of Pass & Seymour, Inc., of Solvay, N. Y., is visiting the Pacific Coast. After attending the jobbers' convention at Del Monte he spent a few days in San Francisco and then returned east by way of Portland and Seattle.

COMPLIMENTARY DINNER TO W. W. BRIGGS.

W. W. Briggs, newly appointed general agent for the Great Western Power Company, was the guest of honor at a dinner at Tait's Cafe on March 3rd, given by the members of the San Francisco organization of the Westinghouse Electric and Manufacturing Company, from which he has resigned as assistant sales manager. His famous "ship story" was in the inspiration of the evening, W. W. Briggs being the commodore and C. E. Heise the captain. The crew assembled on deck at 6 bells and the captain appointed the following officers of the day:

Bucko Mate	R. F. Behan	Gunner's Mate	W. R. Dunbar
Gunner	T. E. Collins	1st Lookout	John Noonan
Purser	A. M. Irwin	2nd Lookout	E. C. Bambaugh
Ship's Cook	L. A. Somers	Messboys	Herbert and Hughes
Davy Jones	W. P. L'Hommedieu	Boatswain	Balzari
Dan McGinty	J. E. Bridges	Coxswain	Graham
Ship's Goat	H. H. Daley	Capt. of the Poop	Capt. Krebs
Cabin Boy	N. K. Cooper	Helmsman	Rosenlund
Chief Engineer	Thos. Anderson	Anchor Man	Hardy
Freight Clerk	Sam Langford	Donkey Man	Johnson
Bugler	Harry De Lancie	Mother Carey	W. C. Cole

The ship then set sail under the strangest orders ever heard on land or sea. Severe storms were encountered, during which it was necessary for all to put on glasses closely imitating those of the commodore. The ship's goat nearly precipitated a mutiny by refusing to produce any more P-918 reports, but the fact that the commodore was about to transfer his flag to the new ship "Great Western" brought peace. A monster loving cup and miniature gold ship were presented with due ceremony and the ship finally brought safely to port on Tuesday morning.

The specifications of material and juice required to transform a negative salesman into a positive dynamic force included the following menu:

Cocktail, Type S.
Oysters, Weldwell. Turtle Creek Soup.
Ripe Olives, Ball-Bearing. Nutty Salesmen.
Bass, Corrugated. Potatoes, Laminated.
(Mis) Steak (Factory Style) Impregnated With Mushrooms.
Heads of Lettuce, Hiflash Dressing. Celery, Wire Type.
Ice Cream, Self-Cooled Type.
Assorted Cakes, Shellac Filler. Cheese, 10,000 k.v.a.
Coffee, Black Marine.
Tipo Chanti, Low Tension. Champagne, High Frequency.
Cigars, Condenser Terminals.

ELECTRICAL DEVELOPMENT AND JOVIAN LEAGUE.

The regular weekly meeting was held Monday, February 3rd, instead of Tuesday, so that the guest of the day, Judge Thomas Deveboise of New York, chief counsel for the Electrical Jobbers' Association, might address the body before leaving California. Judge Deveboise selected for the subject of his address "Our Competitors in Business." Some seventy League members were present.

During the course of his remarks, Judge Deveboise dwelt upon the object of the League—"co-operation"—to make friends of competitors and in that way cut out much of the ruinous competition and a great deal of the unnecessary strife that has existed in the past. The initiative, referendum and recall were touched upon, and an earnest plea for rational legislation affecting the judiciary as well as big business interests. Some of the tendencies of recent years he feared were contrary to the representative government as intended in the Constitution. For instance, in the initiative meetings where the people take out of the hands of their representativs the question of what must or should be covered by legislation. The complaint, said the Judge, from which we have been suffering most particularly is dishonest officials, the whole question, he believed, was one of fair play, and in trying to strike at dishonesty, the public has gone far afield to find the cure, with the result that business interests all over the country are in danger from the attacks upon the courts, the

judges and the legislators. What is wanted is co-operation; that same co-operation, fair play and living up to the rules of the game as is evidenced in the game of golf. The real sport, the true sport, is the man who not only uses his rules in every-day golf, but who plays the game all the time, not some of the time, and I believe the rules of honor that are found on the golf field where the man plays according to the rules of the game, where he is honest to himself, will come to prevail in the electrical business, and it will come if we have true co-operation.

Los Angeles Section A. I. E. E.

The regular meeting of the Los Angeles Section of the American Institute of Electrical Engineers on March 4 was devoted to a discussion of the Institute Proceedings papers on Temperature Corrections, Cable Heating, Oil Switch Ratings and Spark Gap.

Portland Jovian Luncheon Club.

The Jovian Luncheon Club met at the Oregon Grill at noon on Thursday, the 27th. Mr. G. L. Priest acted as vice-chairman. No speaker was provided and only part of the regular business transacted, due to the fact that the chairman of an important committee asked for postponement. Mr. Fred D. Weber was elected to follow Mr. C. P. Osborne as vice-chairman for the month of April.

NEW MEMBERS OREGON SOCIETY OF ENGINEERS.

The following Portland engineers were recently elected members of the Oregon Society of Engineers, there being 36 and not 3 applicants as heretofore erroneously reported:

Ivan C. Anderson, Transitman, City Engineer's Department.
Edward C. Chamberlin Jr., Resident Engineer, F. T. Crowe & Company.
R. R. Clark, Engineer for Lewis A. Hicks Company.
John Dubuis, 23 Ainsworth Building, Civil Engineer.
Charles F. Fisher, care City Engineer, Portland.
H. V. Gates, 253 East Seventeenth St., Civil Engineer.
Clarence Guernsey, Instrumentman, City Engineer's Office.
Chas. S. Goldberg, 1026 East Ninth St. N., Consulting Engineer.
H. R. Hesser, 1087 Belmont St., Transitman.
Oscar A. Kratz, care City Engineer, Draughtsman.
A. F. Morris, care City Engineer, Instrumentman.
O. P. Ramsey, 127 Alberta St., Instrumentman.
John W. Sadler, 1454 Hawthorne Ave., Inspector Construction, City of Portland.
Curtis E. Schindeldecker, Y. M. C. A., Draughtsman-Surveyor.
W. H. Stephens, Chesterbury Hotel, Mechanical Engineer for Dodge Manufacturing Company.
E. R. Weeks, 1111 East Nineteenth St. N., Draughtsman, City Water Office.
Albert D. Vance, 1433 Union Ave. N., Instrumentman.
Otis H. Wright, Assistant Engineer, Portland Water Board.

Junior Members.

Sydney J. Benedict, 502 McKay Building, Draughtsman, City Water Engineer.
Chester G. Ehle, 406½ Park St., Draughtsman City Water Department.
J. S. Gilkey, 332 Tenth St., Deputy Electrical Inspector, City Building Department.
Wm. Hansen, Jr., care City Engineer, Inspector Streets and Sewers.
Wm. H. Heustis, 247 East Thirty-fifth St., Inspector, City Engineer's Department.
Elton I. Kelly, care City Engineer, Inspector Streets and Sewers.
Forest G. King, 898½ Savier St., Draughtsman, Pacific Telephone & Telegraph Company.
G. H. Knowles, 720 East Eleventh St., Transitman.
neer's Office.
John H. Knowles, 720 East Eleventh St., Transitman.
W. H. Lehfeldt, 203½ Jefferson St., Surveyor with P. E. & E Railway Company.
Harry L. Lusted, Lents, Transitman.
Peter R. Madden, 410½ Park St., Instrumentman.
L. S. Newton, 530 East Twenty-seventh St., Computer, City Hall.
W. G. Nicholas, 933 Brooklyn St., Instrumentman, City of Portland.
John W. Peters, 1300 East Sixth St. N., Instrumentman, City Engineer's Department.
W. F. Power, 581 East Twenty-eighth St., Chainman, City of Portland.
William Rueter, care F. T. Crowe & Co., Assistant Resident Engineer, F. T. Crowe & Company.
Rollo K. Stevens, 188 Hamilton Ave., Surveyor.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Feb. 15.

The Railroad Commission rendered a decision denying without prejudice the application of the Arrowhead Reservoir & Power Company to issue $4,000,000 of bonds. Suits were pending against the company in the Superior Court of San Bernardino county and in the United States Circuit Court at Los Angeles, and the Commission held that it would be improper to authorize an issue of bonds on property in controversy.

A decision was rendered granting the application of the San Diego Consolidated Gas & Electric Company to issue $204,000 of bonds.

The Commission rendered a decision denying the application of the Saratoga Telephone Company to increase its rates, and directed that the Pacific Telephone & Telegraph Company proceed to render service in and about Saratoga at the rates on file with the Commission.

Feb. 17.

G. K. Estes, owner of the Morgan Hill Telephone Company, and T. H. Dassel, joined in an application for the sale of the telephone company by Estes to Dassel, for $2500.

A decision was rendered granting the application of the Long Beach Consolidated Gas Company for a certificate of public convenience and necessity to exercise franchise rights previously granted by the Board of Supervisors of Los Angeles county. The Commission also rendered a decision authorizing the transfer to the Long Beach Consolidated Gas Company of a franchise previously granted by the county of Los Angeles to George H. Bixby.

A decision was rendered dismissing without prejudice the application of the Mountain Power Company for a certificate of public convenience and necessity to construct and operate an electrical plant in Del Norte county. The application was dismissed upon request of the applicant.

The Imperial Valley Gas Company was given authority to proceed to issue $154,500 in bonds. In the original order the bonds were made dependent upon a pending franchise application which has since been granted.

Feb. 18.

The City Electric Company of San Francisco applied for authority to sell $833,000 of bonds which it had been previously authorized to pledge as collateral security.

Feb. 19.

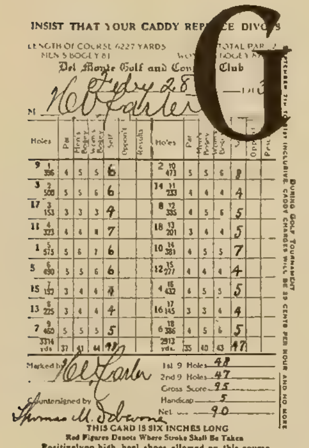
A decision was rendered granting authority to the Vallejo & Northern Railroad Company to sell all its property to the Northern Electric Railway Company in exchange for $1,000,000 of Northern Electric Railway bonds. The Vallejo & Northern receives as additional compensation, $2,000,000 of the capital stock of the Northern Electric Railway Company.

The Pacific Telephone & Telegraph Company applied for a re-hearing upon the case involving physical connection with the Tehama County Telephone Company and the Glenn County Telephone Company.

Feb. 20.

A decision was rendered denying the application of the Midway Gas Company for a certificate of public convenience and necessity to transport and distribute natural gas from the Midway fields, in Kern county, to Los Angeles and other points in southern California. The Commission found that under the proposed plan of purchase of the gas, the lands in controversy as between the United States Government and the Southern Pacific Railroad, would be largely drained of the gas supply, to the financial advantage of the Southern Pacific and allied companies, before the question of title could be determined; and that the organization of the project was such as to create a monopoly of the natural gas in the Midway fields. The Commission stated that the general project was a meritorious one and that if the company removed the objectionable features of the contracts, the Commission would view it with favor.

JOBBERS AT DEL MONTE.



GOLF, recreation and cooperation engaged the attention of more than the allotted three score and ten electrical men and their wives who attended the quarterly week-end meet of the "Pacific Coast Electrical Golfers' Association" at Del Monte, California, Feb. 27, 28 (29) and March 1. Notwithstanding that this is not leap year and that the "no-days" are yet to come, all present or accounted for agreed that far more than a week's joy was crowded into the three brief days available.

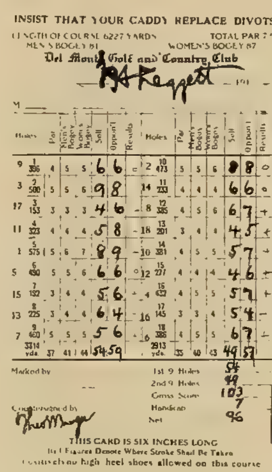
Golf eclipsed in interest even the recreations enjoyed during the hours of the Mazda lamp, whose "only rival" sustained the reputation of Del Monte as a most delightful winter resort. Golf engulfed the jobbers to the exclusion of all other forms of cooperation also, for be it known to you, my reader, no golfer can long refrain from being a cooperator. The spirit of the game makes for beneficial competition, honesty and belief in your fellow man. Obstructions, such as bunkers or other forms of competition are carefully avoided and every attempt is made to keep in the fairway.

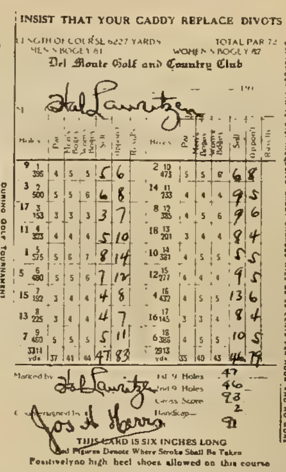
Cups by the capful were captured by the cronies of the cussed handicap committee, causing cupidity in the cramped cupboards under the cupolas where cupid lurks in the shadows. First came the cupric jobbers cup upon which F. W. Leggett's name will hereafter shine, this also carrying with it the right to the Patton cup and the Del Monte goblet given for a good gobble. Next came H. V. Carter, whose canny caddie enabled him to win the Eveready and Arrow E cups, the last named being won by Colonel Carter against Colonel Bogie with 4 down. He has justly earned another title to be appended to the long list with which his illustrious name is already adorned. Instead of "H. V." it is now Hebe, mythological tradition informing us that Hebe was the cup bearer to the gods, while the colonel is the cup winner of the jobbers. The contractor's cup for the lowest gross score was won by C. C. Hillis.

Following are the scores in the Jobbers' Tournament:

	Gross.	Jobbers.	Eveready.	Patton.
C. B. Hall	123	115	113	115
Ross Hartley	131	109	109	109
H. V. Carter	95	101	*95	101
T. M. Debevoise	109	109	109	109
C. C. Hillis	94	102	103	102
W. S. Berry	99	112	104	112
D. Reynolds	99	99	99	99
T. E. Burger	116	105	105	105
Fred Leggett	103	*96	104	*96
F. N. Killam	128	104	104	104
F. N. Averill	122	124	116	124
A. E. Elliott	116	110	110	110
F. Overbagh	118	108	108	108
W. L. Goodwin	104	117	109	117
R. D. Holabird	101	116	110	116

The manufacturers made hay out of the green grass of the putting greens, while the jobbers were putting up jobs against them. The first game resulted in a tie between John





R. Cole and H. N. Lauritzen, the latter later winning by a gross of 93 and a net of 91 in the course of the foursome for the Century cup.

The scores in the Manufacturers' Tournament were as follows:

	Gross.	Net.
T. E. Bibbins	101	97
John R. Cole	116	92
W. R. Dunbar	121	97
C. C. Emery	146	122
S. B. Gregory	114	110
J. A. Herr	158	134
W. Brewster Hall	126	107
P. B. Hyde	115	95
H. N. Lauritzen	94	92
F. H. Poss	118	105
H. V. Squires	127	103
H. E. Sanderson	99	114
W. H. Seaver	135	111
K. E. Vankuren	122	89

The true co-operation of the meet came on Saturday afternoon, when a jobber and manufacturer emulated jobber and manufacturer in a handicap foursome for two beautiful cups contributed by R. J. Davis of the Century Electric Company. As these cups had no strings on them they were taken home by F. N. Killam and H. Brewster Hall, whose combined game showed a net of 183.

The pool tournament was won by Duncan Reynolds, Garnett Young being runner-up.

Of the score of ladies present the best score in the putting contest was made by Mrs. A. G. Young who is now the proud possessor of a beautiful piece of feminine adornment. Dancing was indulged in every evening, the ballroom being given over to the electrical party exclusively on Friday night. Mrs. W. S. Berry entertained at a tea on Friday afternoon and various other pleasant partimes were arranged.

The golf dinner on Saturday night was the crowning feature of the convention. Here the cups were presented to the winners with most appropriate ceremony and later were properly dedicated by the recipients. H. V. Carter presided as toastmaster and called for toasts on the Ladies, the Press, and also from Judge Debervoise, as well as from the cup winners.

W. L. Goodwin and associates created much amusement by a number of take-offs on the speakers, while at the other end of the room some excellent harmony was staged under the direction of R. D. Holabird, the book being by Mrs. H. N. Lauritzen and the music arranged by H. E. Sanderson.

Some of the effusions are produced herewith, though it must be confessed that the best are unfortunately lacking. It is no more than just to say that most of the prayers were answered:

To the music of *"Harrigan."*

"L, E double G, E double T spells Leggett,
We're proud of all his winnings on the golf course.
His wife and his baby, too, we'll say
L, E double G, E double T, you see,
He's a winner every time, but will he buy the wine?
WILL HE? WE'LL SEE!"

To the music of *"Rings on Her Fingers."*

"Col. Carter, the Golfer, he won a cup today,
How he ever did it, we really cannot say.
The handicap committee will please investigate;
Perhaps the Col. himself will buy before the hour's too late."

To the tune of *"Blest Be the Tie."*

"Here's to our old friend, Brewster Hall,
He won a big cup, that's not all.
He won a big cup, but he won't fill it up,
So we don't think much of him at all.
In connection with old Brewster Hall
Was a partner who is certainly tall.
Although not a villain, his name is Frank Killam;
We hope for a drink, now that's all.
Fred Leggett came through with the wine,
Perhaps Brewster will buy it some time.
But the old golf committee
Now sings him a ditty,
He'll think ere he wins next time."

In addition to Franklin Overbagh, the secretary of the National Association and Judge Thomas M. Debevoise, a number of other eastern representatives were present, including H. B. Kirkland, general sales manager of the American Conduit Manufacturing Company; Robert Kuhn, secretary American Electrical Heater Company; E. K. Patton, western manager of the Bryant Electric Company; W. W. Low, president of the Electric Appliance Company, and B. E. Salisbury, vice-president, treasurer and general manager of Pass & Seymour, Inc.; Harry Adams of the Philips Insulated Wire Company, and Mr. Lutchen of Butte, Mont.

Golf Dinner at Del Monte.

Others present at the banquet included:

Mr. and Mrs. W. S. Berry, Western Electric Co., San Francisco.
Mr. and Mrs. T. E. Bibbins, General Electric Co., San Francisco.
Mr. and Mrs. A. E. Elliott, Secretary Jobbers' Assn., San Francisco.
Mr. and Mrs. J. A. Herr, Sprague Electric Works, San Francisco.
Mr. and Mrs. H. N. Lauritzen, Holophane Co., San Francisco.
Mr. and Mrs. F. H. Leggett, Western Electric Co., San Francisco.
Mr. and Mrs. W. W. Low, Electric Appliance Co., Chicago.
Mr. and Mrs. E. K. Patton, Bryant Electric Co., Chicago.
Mr. and Mrs. F. H. Poss, Benjamin Electric Co., San Francisco.
Mr. and Mrs. H. E. Sanderson, Bryant Electric Co., San Francisco.
Mr. and Mrs. H. V. Squires, Manufacturers' Agent, San Francisco.
Mr. and Mrs. K. E. Vankuren, Westinghouse Elect. & Mfg. Co., Los Ang.
Mr. and Mrs. A. G. Young, Telephone & Electric Equipment Co.
F. N. Averill, Fobes Supply Co., Portland.
T. E. Burger, Western Electric Co., Los Angeles.
Munson Burton, Westinghouse Lamp Co., San Francisco.
H. V. Carter, Pacific States Electric Co., San Francisco.
John R. Cole, Manufacturers' Agent, San Francisco.
H. H. Daley, Westinghouse Electric & Mfg Co., San Francisco.
R. J. Davis, Century Electric Co., San Francisco.
W. R. Dunbar, Westinghouse Electric & Mfg. Co., San Francisco.
C. Gilson, Pacific States Electric Co., Oakland.
Ross Gilson, Pacific States Electric Co., Oakland.
W. L. Goodwin, Pacific States Electric Co., San Francisco.
S. B. Gregory, Arrow Electric Co., San Francisco.
E. B. Hall, Illinois Electric Co., Los Angeles.
W. B. Hall, Pass & Seymour Co., San Francisco.
A. H. Halloran, Journal of Electricity, Power & Gas, San Francisco.
Ross Hartley, Pacific States Electric Co., Portland.
C. C. Hillis, Electric Appliance Co., San Francisco.
R. D. Holabird, Holabird-Reynolds Co., San Francisco.
P. D. Hyde, Electric Battery Supply Co., San Francisco.
F. N. Killam, Pacific States Electric Co., Seattle.
G. I. Kinney, Sprague Electric Co., San Francisco.
F. H. Murray, National Carbon Co., Los Angeles.
Duncan Reynolds, Holabird-Reynolds Electric Co., Los Angeles.
W. H. Seaver, American Steel & Wire Co., San Francisco.
L. E. Sperry, N. Y. Insulated Wire & Cable Co., San Francisco.
J. A. Vandegrift, Oakland Warehouse, Oakland.
C. E. Wiggin, Dunham, Carrigan & Hayden, San Francisco.

OREGON TECHNICAL CLUB.

The first luncheon, February 25, 1913, was held in one of the Commercial Club dining rooms and was presided over by Mr. W. D. Scott as chairman, and the speaker of the day was Mr. Fred Spoeri, commercial manager of the Pacific Telephone and Telegraph Company of Portland, Oregon.

Mr. Spoeri said:

A little more than thirty-five years ago, the Nation celebrated its birth at the Philadelphia Centennial. At that great exhibition, in a little out-of-the-way corner, set the first crude telephone. It was passed unheeded for six weeks by throngs of people until finally Don Pedro, then Emperor of Brazil, brought it to the attention of the judges. From that moment, it received the greatest attention throughout the remainder of the exhibition.

Financial men laughed outright at Dr. Bell's scheme to sell his patent for a hundred thousand dollars. It was scoffing of the same sort that Morse had received forty years before, when he tried to induce the government to pay him sixty thousand dollars for his pet, the telegraph. Today, the telephone system that bears the name of the inventor has more than fifteen million miles of wire in operation—enough to girdle the earth many hundreds of times. The value of the telephone properties in the United States today aggregate a sum that makes the hundred thousand dollars that Dr. Bell requested look like the proverbial thirty cents.

It was not long before the march of progress seized upon the telephone. The wizards of the electrical field put their time into perfecting the scientific toy. The usefulness of the instrument increased, and with it a demand for a share in its benefits. Today the annual earnings of the telephone in the United States are in excess of two hundred million dollars.

The fact that Dr. Bell, himself, is alive to see the wonderful conquest of his toy, emphasizes the usefulness of the telephone. Today every business man has a telephone at his elbow, and finds it his most trustworthy assistant. It has invaded the home, saving time and steps, providing protection and effecting means of social diversion. It has smoothed the way for thousands of railroad trains, and is used on forty-seven thousand miles of road for dispatching trains, with never an accident due to its use. It has vanished isolation on more than two million American farms, for in the rural districts the telephone has done the most good.

What will come next? Our army of engineers are constantly at work planning and devising new wonders with the telephone. The rapid spread of service over the wires shows no signs of abating, and telephone men declare the future is most rosy. Even now, conversations are being held between New York and Denver, a distance of two thousand and sixty-six miles, while our engineers and construction force are completing two long distance lines from the Atlantic Coast to the Pacific. It only costs eleven dollars and twenty-five cents for a three-minute conversation between Denver and New York, and, based on this rate, the charge from San Francisco to New York would be approximately sixteen dollars for three minutes' use of property that will be valued at several millions. It now takes four days to cross the continent, at a cost of over one hundred dollars. Before the end of this year you will be able to send your voice and your personality from the Atlantic Coast to the Pacific at a cost of about sixteen dollars, and it will only take you three minutes.

Our engineers can tell you all about how this can be made possible with the aid of loading coils, which are the invention of Prof. Pupin.

Our equipment engineer installs the switchboards and apparatus that will make it easier and better for you to talk. If you have any trouble with your service, don't make the mistake and blame the operator, it's not her fault; blame the engineers. They make the switchboards.

The Pacific Coast has a higher telephone development than any other part of the country. The city of Portland, according to best information, ranks in third or fourth place as having more telephones per one hundred population than any city in the United States. In the year 1882, there were only three hundred and fifty-two telephones in Portland; today, there are over forty thousand telephones of this company alone, in addition to those of the other company. Last year we made a net gain of five thousand, two hundred and ninety-three telephones in Portland, and it may interest you to know that our operators answer approximately two hundred and fifty-six thousand calls each day, or an average of nearly seven calls per telephone.

Right at this point it may be well for me to let you into a secret. We have been asked frequently as to the advisability of an automatic system of telephones, but our company believes that they have perfected a system now that will revolutionize operating conditions that is part automatic and part manual. In fact, it is known as the automanual switchboard. Instead of an operator making the connection, as at present, she will only have to press the buttons of a keyboard similar to that of a typewriter, etc.

To Mr. Theodore N. Vail is due the credit of having brought about the union of the telephone and the telegraph. By oombining the plants of the telephone and the telegraph, many betterments and economies can be made. At the present time, two circuits can be made into three, the third being known as a phantom circuit. Three separate telephone conversations can be carried over these two circuits, while eight telegraph messages can be transmitted without interference with each other. Just think of it, two pair of wires with six people carrying on three separate conversations, while these same two pair of wires are used by sixteen other people sending eight separate telegraph messages. It almost seems too incredible to believe.

Perhaps you will be interested in knowing something about our operating conditions, and the work of the operators. Few people are familiar with the duties of the young women employed as telephone operators. There are over six thousand young women employed in this work. The telephone operator must possess natural intelligence, good health, quickness in thought and action, and a pleasant disposition. Unlike other lines of work open to young women which require special training, the telephone company provides its own schools and pays the employes while they are learning. In the larger offices, lunch rooms are maintained, where wholesome food is served at actual cost. Each telephone exchange has an attractive and comfortable rest room for the convenience of the operators when not on duty, where magazines, and in many cases libraries, are furnished.

No operator works over eight hours in any one day, and not over four hours at any one time. Each city has a welfare matron, whose duty it is to visit the girls at their homes when absent or ill, and assist them in improving their working and home conditions, supplying medical aid where necessary.

On January first, the Bell Telephone Company and its associated companies inaugurated a pension plan, whereby women and men are pensioned after a certain number of years of service, also providing accident, health and death benefits. Employes are paid while injured or sick, ranging from four weeks to thirteen weeks at full pay, and from thirteen to thirty-nine weeks at half pay, depending upon the length of service. Ten million dollars has been set aside as a reserve fund, and it is estimated that it will cost the company about one million dollars a year for this benefit and pension plan.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

STANDARD SPECIFICATIONS FOR WIRING BUILDINGS.

(Continued.)

Example No. 2. For conduit work in a store, office or hotel building in the underground district having only individual meters for the various tenants and no master meter.

Service.

(61) The Portland Railway, Light and Power Company will bring 120-240-volt direct-current lead-covered service cables into the basement at the point shown on plans, and furnish and install a main service switch and cutout.

(62) From this point the wiring contractor is to run three (3) conductors for the entire service to the meter board as located on basement plans.

Meter Board.

(63) The Portland Railway, Light and Power Company will furnish and install the meter board and all necessary wiring on same ahead of the meters.

Meters.

(64) Standard General Electric Company's recording watthour meters arranged for side connection will be furnished and installed by the Portland Railway, Light and Power Company.

Lighting Feeders.

(65) From their respective meters on the meter board above mentioned, sets of three (3) conductor feeders are to be run as follows:

(a) One to the branch cutout cabinet in each of the —— stores.

(b) One of No. 10 rubber-covered wire, in metal conduit, for each of the —— sign services, to the switches located under the windows in the entrances of the above-mentioned stores, and from here to a point over the entrance, and sufficient wire left extending for future connections to signs.

(c) One to the various branch cutout cabinets of the hotel located on the second and above floors.

Power Feeders.

(66) From their respective meters on the meter board above-mentioned, sets of two (2) conductor feeders are to be run as follows:

(a) One to the three 20-h.p. elevator motors at the foot of the elevator shaft in basement.

(b) One to the 10-h.p. ventilating system motor in room for same in basement, as shown on plans.

(c) One to the 5-h.p. ventilating system motor in the south wing of the fifth floor at the point shown on plans.

(d) One to the 2-h.p. ventilating system motor in kitchen on the eighth floor, at the point shown on plan.

Copy clause (43).

Cutout Cabinets, Branch Circuits, Switches.

Copy specifications shown in Example 1.

Example No. 3. For concealed knob and tube work in a store, office or hotel building in the underground district having only individual meters for the various tenants and no master meter.

Service.

Copy clause (61).

(67) From this point, the wiring contractor is to run three (3) conductors for the entire service in metal conduit to the meter board as located on basement plans.

Meter Board.

Copy clause (63).

Meters.

Copy clause (64).

Lighting Feeders.

Copy clause (65).

Note.—Sign feeders must always be in conduit, per requirement of Portland Railway, Light and Power Company.

Power Feeders.

(68) From their respective meters on the meter board above mentioned, sets of two (2) conductor feeders are to be run as follows:

(a) One to the 10-h.p. elevator motor at the foot of the elevator shaft in basement.

(b) One to the 10-h.p. ventilating system motor in room for same in basement as shown on plans.

(69) These feeders are to be run to the points indicated and terminated in wooden switch cabinets, same to be thoroughly lined with asbestos and painted to comply with all rules and requirements. The doors are to be fitted with suitable spring latches and hinged at the top so as to be self-closing. In these cabinets are to be mounted proper switches and cutouts and provision made for future connection of motor leads.

Cutout Cabinets.

(70) On each floor, from the first to the top floors, both inclusive, at the positions shown on plans, wooden cutout cabinets are to be furnished and installed, same to be lined with asbestos and painted to comply with all rules and requirements. The doors of same are to be fitted with suitable spring latches and hinged at the top so as to be self-closing. The cabinets are to contain the necessary three-to-two wire combination knife switch and plug cutout branch blocks.

(71) The wiring contractor is to furnish all the necessary fuses for these cutouts and one extra set in addition.

Copy last two clauses of Example 1.

Branch Circuits, Switches.

Copy clauses Example 1.

(To be continued.)

TRADE NOTES.

The Southwestern Electric Company, which was recently reorganized in El Paso, is moving into its new quarters at Chihuahua and San Francisco streets. The company will put in a $75,000 stock of electrical machinery and appliances, and their operations will cover the entire southwest. V. E. Raggio will continue as manager.

The California, Oregon Grain & Elevator Company is constructing a warehouse and grain elevator in Portland, Oregon. It will be ten stories in height and built of reinforced concrete. There is to be installed approximately 400 h.p. in 3-440 volt induction motors, the sizes ranging from 5 h.p. to 75 h.p. In addition there will be installed approximately 300 lights for general illumination.

Chas. C. Moore & Company have secured the contract for the equipment of the steam plant for the Northwestern Electric Company. This will consist of six 500 h.p. Stirling boilers and superheaters and two 3500 kw. turbine generators of General Electric Company make. It is to be auxiliary to the White Salmon plant of the Northwestern Company. The building in which the equipment will be housed is being designed by Ben McDougal, architect, San Francisco.

EXAMINATION FOR ELECTRICAL DRAFTSMAN (MALE).

The United States Civil Service Commission announces an open competitive examination for electrical draftsman in the Isthmian Canal Service, for men only, on March 19 and 20, 1913. The entrance salaries of the positions to be filled as the result of this examination are as follows: Electrical draftsman, first class, $150 a month; second class, $125 a month.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—Gas Improvement Company, $100,000, subscribed $500, by N. Bridge, A. Ross, P. H. Harwood, S. Monteleone, and O. Wellborn Jr.

SAN FRANCISCO, CAL.—Sierra Mining, Milling & Power Company, $200,000, shares $1 each, subscribed $400, by L. I. Royland, H. G. Royland, C. P. Pratt and R. L. Egenhoff.

SALEM, ORE.—Articles of incorporation were filed for the Oregon Railway Company to operate between Salem and Bend. The incorporators are J. F. Mounce, A. L. McLeod and G. A. Kylwand and the capital stock is fixed at $500.

SAN DIEGO, CAL.—Articles of incorporation for the Mexico & San Diego Railway Company have been filed with authorized capital of $215,000. The incorporators are E. S. Babcock, president; R. B. Talbott, L. M. Brown, A. Goodrich, and Thomas M. Leevey. All are officials of the Los Angeles & San Diego eBach Railroad. The new company proposes to build a road from National City to the salt works at South San Diego, which are owned by Babcock.

ILLUMINATION.

GALT, CAL.—A lighting system through both the residence and business districts of Galt will be installed shortly.

MOUNTAIN VIEW, CAL.—The board of trustees has decided to call an election for the purpose of voting on a proposition to bond the town for a municipal light and power plant, to be added to the municipal water works.

BURBANK, CAL.—An election has been called for March 26th, for the purpose of submitting to the qualified voters the question of incurring a bonded indebtedness for constructing water works and electric light works. The amount of bonas proposed is $50,000 for a waterworks system, and $20,000 for an electric light system.

CORVALLIS, ORE.—Madison street property owners state that they will install cluster light poles complete if the city will furnish power.

TRANSPORTATION.

PHOENIX, ARIZ.—The El Paso & Southwestern Railway Company has applied for permission to issue $3,500,000 of bonds to cover expenses of the Tucson extension.

SEATTLE, WASH.—Rainier Valley Commercial Club are working to have the proposed Northwestern Electric Company interurban between Portland, Olympia and Seattle enter Seattle through Dulap canyon.

ASHLAND, ORE.—Ashland has voted to grant a franchise to M. T. Minney and his associates of Oakland, Cal., for an interurban and a street railway. The same parties were granted a franchise in Medford a few weeks ago. The company promises to commence work at once.

ASHLAND, ORE.—The Minney street railway franchise has been granted for the purpose of developing the street railway system in this city. A like franchise has been recently granted in Medford and it is the purpose of the Minney Company to connect the two cities. Hill interests are reported back of the enterprise.

LOS ANGELES, CAL.—The Los Angeles Railway corporation, which has just sold $3,000,000 5 per cent bonds to Harris, Forbes & Company, operates 371 miles of street railway in Los Angeles, of which 355 miles is owned, and 16 miles leased from the City Railway Company, all of the stock of which is owned by the Los Angeles Railway Corporation. The bonds are part of an authorized issue of $20,000,000 5 per cent first and refunding bonds, of which $14,500,000 have been issued, and no additional bonds can be issued except to retire, at par, the present outstanding issues of underlying bonds, of which there are $5,500,000. The company has $20,000,000 capital stock.

PORTLAND, ORE.—According to the budget, the Portland Railway, Light & Power Company will spend $4,000,000 in improvements this year; $2,500,000 to be used for railroad construction, new buildings, equipment, repairs and other improvements in connection with the city and suburban lines. About $1,500,000 will be expended for the light and power departments.

PORTLAND, ORE.—L. M. Lepper at a meeting of the transportation and subways committees of the East Side Club, stated that the movement for cross town lines is well under way and will be submitted to the trustees of the Portland Railway, Light & Power Company soon. Complaints have been filed with the state railroad commission demanding four cross town lines as well as other improvements.

SAN FRANCISCO, CAL.—Without a dissenting vote, the Supervisors passed the ordinance ordering the construction of the Van Ness avenue extension of the Municipal Railway. It directed the Board of Public Works to prepare plans and specifications. While the board was still in session, Mayor Rolph and Clerk Dunnigan signed the bill and it is now a law. The Supervisors also prepared the way for the construction of a "municipal short line" from the Geary-street line through the Fillmore-street tunnel and on to the fair grounds. They adopted a resolution "declaring that the public interest and convenience require and that it is the intention of the Supervisors to order the construction of a tunnel and to acquire lands in connection therewith in Fillmore street, between Sutter and Filbert streets."

SAN FRANCISCO, CAL.—Six bids were received by the board of public works for the construction of the roadbed of the municipal railway's extension down Market street from the junction of Geary and Kearny streets to a union with the so-called "outside tracks" at Sansome street, whence the rails will be used jointly to the Ferry loop by the city's street cars and the Sutter street line. Of the six bidders two were tied—Frank E. Hilmer and F. Rolandi—both offering to do the work for the same price, $21,990. The Healy-Tibbitts Construction Company was highest with a bid of $34,000. The others were: H. C. Storrie, $26,000; Contra Costa Construction Company, $25,000; A. J. Reisch, $26,920; Central California Construction Company, $23,800; and Union Construction Company, $24,248. Rolandi was awarded the contract.

TRANSMISSION.

NEW WESTMINSTER, B. C.—Westminster Power Compan, Ltd., Corbould, Grant & McColl, Solicitors, are planning a hydroelectric power plant near here.

POCATELLO, IDAHO.—J. D. Browning and L. R. Martineau of Salt Lake, who have applied for a power transmission franchise, are planning a hydroelectric power enterprise.

PORTERVILLE, CAL.—Work is to be started within the very near future on an additional power line for the San Joaquin Light & Power Company to connect the Strathmore substation of the company with the substation at Famosa.

ST. JOHNS, ARIZ.—The city clerk has been instructed to prepare and publish notice of the board of trustees' intention to grant a franchise to the Little Colorado Light &

Power Company for constructing power lines and distributing lines along certain roads of Apache county and the streets of St. Johns.

SAN FRANCISCO, CAL.—All the outstanding bonds of the Stockton Gas & Electric Corporation have been called for payment of 106 and interest at the Mercantile Trust Company, of San Francisco on or before January 1, 1914. These bonds are being retired in new financing of the Western States Gas & Electric Company, which controls the Stockton company.

LOS ANGELES, CAL.—The Oak Forest Land & Water Company has sold 210 acres of hill and canyon land in the Watts subdivision of Rancho San Rafae to the Pacific Light & Power Company, who will erect a transformer station on the site to handle the high voltage power coming down from the Big Creek project. This station, when completed, will handle nearly 300,000 horsepower.

OLYMPIA, WASH.—The bill now before the Washington legislature to prohibit the transmission to another state of power generated in this state, aimed directly at the Northwestern Electric Company of Portland, will be killed. The Northwestern Electric Company under the agreement will retain its riparian rights and its power plant on the White Salmon River, allowing the irrigationists of Horse Heaven country to utilize the Klickitat water for the reclamation projects now being developed.

SEATTLE, WASH.—Nixon-Kimmel Company, engineers and contractors, 126 Lincoln street, Spokane, has completed a hydroelectric power plant on Methow River, near Pateros, Okanogan county, Washington, and is supplying power to ranchers for pumping water from the Columbia River to irrigate land. The power project consists of a wing dam, a 1000 foot earth and rock canal and a 1000 foot flume, giving 22 ft. head at the foot of the flume, where they installed two 30 ft. Leffel water wheels and a 180 kw. Westinghouse generator. The pumping plants along the Columbia in this locality require a lift of 30 to 125 ft. The flume of the Nixon-Kimmel plant carries about 600 second ft. of water.

TELEPHONE AND TELEGRAPH.

COLVILLE, WASH.—A telephone company is being organized to extend the farmers' system from Colville to Pend Oreille lake along the state road 27 miles.

HARLOWTON, MONT.—The Meagher County Telephone Company voted to expend $2000 for switchboard and improvements and extensions of the plant and toll line.

BISBEE, ARIZ.—Work has been started by the Mountain States Telephone Company on its third toll line between Bisbee and Douglas. The line will be 27 miles long.

VANCOUVER, B. C.—The British Columbia Telephone Company are making preliminary plans for laying a new cable connection between the mainland and Vancouver Island.

LOS GATOS, CAL.—The Los Gatos Telephone Company has applied to the commission for authority to increase its stock issue by $25,000 for the purpose of adding to its plant.

GUADALAJARA, MEXICO.—The Mexican Telegraph & Telephone Company has started work on a new telephone system and material for a new building is being assembled. The telephone building will be a two-story brick, stone, concrete and steel construction and will be divided into offices and a central exchange. The cost will be about $500,000, Mexican currency.

HONOLULU, HAWAII.—At a special meeting, after the annual meeting, the Mutual Telephone Company decided to increase its capital stock from $400,000 to $750,000. The additional $350,000 stock will be placed in the treasury to be used at the discretion of the directors, chiefly for improvements in Honolulu. In the neighborhood of $100,000 will be required this year for extension of the system and new phones in the city. Although the rest of the additional capital may not be required for some years, it was deemed best to provide for future needs, so that the company would not have the trouble of increasing the capital stock from year to year. At present there are 4300 phones in use, and the number will probably be increased to more than fiev thousand this year.

OAKLAND, CAL.—The suit by the city of Berkeley against the merger of the Home Telephone Company with the Pacific Telephone & Telegraph Company has been dismissed by Superior Judge Waste. Demurrers to the suit filed by the company were sustained six weeks ago, and the failure of the city to amend its complaint was cited as ground for giving judgment in favor of the defendant companies. Judge Waste stated that the Supreme Court had determined that the city had no right to include provisions in its charter grant to corporations which could not be legally enforced. The suit as filed was based on provisions in the charter to the Home company forbidding its sale to a competing company. Laws supporting this feature of the charter were not in effect at the time of its grant.

SEATTLE, WASH.—Municipal telephone systems for Spokane, Tacoma, Portland, Seattle, and any other cities in Oregon and Washington which may wish to adopt such a system and combine with the others to form the nucleus of a long-distance telephone system, were recently discussed at an informal meeting. Mayor Cotterill presided, and Superintendent of Public Utilities A. L. Valentine, Superintendent of Lighting J. D. Ross, City Electrician Howard Joslyn, Councilmen E. L. Blaine, Charles Marble, Austin E. Griffiths, Robert B. Hesketh, Oliver T. Erickson, John G. Peirce and A. F. Haas were present to represent the interests of Seattle. Mayor W. W. Seymour of Tacoma, and Commissioners Lawson, Freeland and Miles from that city, and Samuel Hill, president of the Home Telephone Company of Portland, Ore., urged the necessity of competing telephone systems in all cities. No definite action was taken.

WATERWORKS.

BAKER, ORE.—The $165,000 bond issue voted on for municipal water system purposes was defeated by a small majority.

TULARE, CAL.—The Tulare City Water Company has agreed to sell its plant to the city for $30,000 or $14,000 less than the price heretofore asked.

OXNARD, CAL.—Sealed bids will be received up to April 1st by the city clerk for the purchase of 200 of municipal water works bonds, 1912; each of said bonds are of the denomination of $300; dated May 1, 1912. Said bonds bearing interest at the rate of 5 per cent.

VENTURA, CAL.—Sealed bids will be received up to March 18th, by the board of supervisors for a franchise applied for by the Ojai Power Company, granting the right to maintain and construct pipe lines and water system, and all incident appurtenances necessary therefore, for conveying water and furnishing same to Nordhoff, Ventura county.

SANTA MONICA, CAL.—Acting upon recommendation of consulting water engineers, Quinton & Code, the city will abandon all thought of installing a salt water fire protection system, and will at once prepare plans providing for a system of fresh water mains to serve the business and amusement districts. The estimated cost, $75,000, will be met through the creation of an assessment district.

SANTA PAULA, CAL.—The San Cayetano Mutual Water Company has contracted with Frank Hardison to drill a large well on ground purchased for that purpose. It is located near the pumping plant of the Sespe ranch. The water developed will be for use of stockholders, there being 700 acres represented in the corporation. They will put in a large pumping plant and will lift water 400 ft.

ALPHABETICAL INDEX TO ADVERTISERS

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Manhattan Elec. Supply Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.
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Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Manhattan Elec. Supply Co.
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

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Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

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Geo.E.DowPumpingEngineCo.
"Le Blanc" Westinghouse Machine Co.

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K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Dow Pump'g Engine Co., Geo.E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.

Economy Electric Co.
San Francisco, 444 Market

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 726 Mission
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor," Pierson, Roeding & Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
Pierson, Roeding & Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Tungsten, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.
Manhattan Elec. Supply Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
Fairbanks, Morse & Co.
General Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Pittsburg Piping & Equip. Co

Plugs, Flush
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks, Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo. (Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Push Buttons
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Manhattan Elec. Supply Co.
San Francisco, 403 Atlas Bldg., 604 Mission St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Moloney Electric Co.
San Francisco, Rialto Bldg.

Nason & Co., R. N.
San Francisco, 151 PotreroAve.

Na[illegible]on. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco,MonadnockBldg

Post Co., The Frederick
San Francisco, 135 Second

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer.
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
LosAngeles, Union Trust Bldg

Searchlights
Fort Wayne Electric Works
General Electric Company

Separators, Steam
Pittsburg Piping & Equip. Co.

Shades
Benjamin Elec. & Mfg. Co.

Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.

Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.

Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.

Surveying Instruments
Post Co., The Frederick

Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company

Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.

Steel Castings
Columbia Steel Co.

Street Cars
"Brill," Pierson, Roeding & Co.

Switches, Float
General Electric Company
Westinghouse E. & M. Co.

Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Westinghouse E. & M. Co.

Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Switches, Knife
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.

Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.

Switches, Push Button
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Switches, Snap
The Cutler-Hammer Mfg. Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Switches, Solenoid
The Cutler-Hammer Mfg. Co.

Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.

Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company

Tanks, Steel.
Western Pipe & Steel Co.

Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.

Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company

Towers, Steel.
Pierson, Roeding & Company

Transformer Winding.
K-P-F Electric Co.

Tubes and Bushings
Ohio Brass Company

Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Moloney Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.

Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.

Turbines, Water.
Pelton Water Wheel Co.

Valves
Pittsburg Piping & Equip. Co.

Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.

Washing Machines
Pacific States Electric Co.
Western Electric Co.

Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee," Simonds Mchy Co.

Wire, Aluminum.
Pierson, Roeding & Company

Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company

Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.

Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company

Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.

Wire, Enameled.
General Electric Co.
Western Electric Company

Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company

Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.

Wire, Trolley.
Bridgeport Brass Company

Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.

Van Emon Elevator Co.
San Francisco, 56 Natoma.

Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company

Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758 W. Broadway

Westinghouse E. & M. Co.
Denver, 1052 Gas & Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.

Westinghouse Machine Co.
San Francisco, 141 Second

Westinghouse-Church-Kerr Co.
San Francisco, 839 Pacific Blg.
Los Angeles, Cal., Pacific Electric Bldg.

Weston Elec. Instrument Co.
San Francisco, 682-684 Mission

Wilson Machinery Co.
San Francisco, 361 Market

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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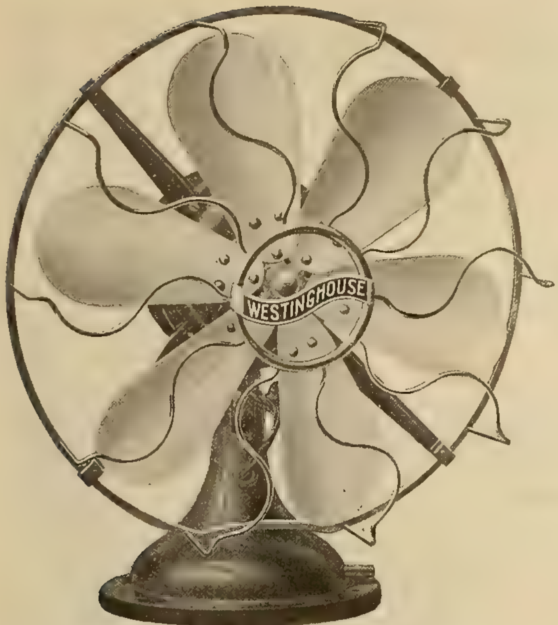
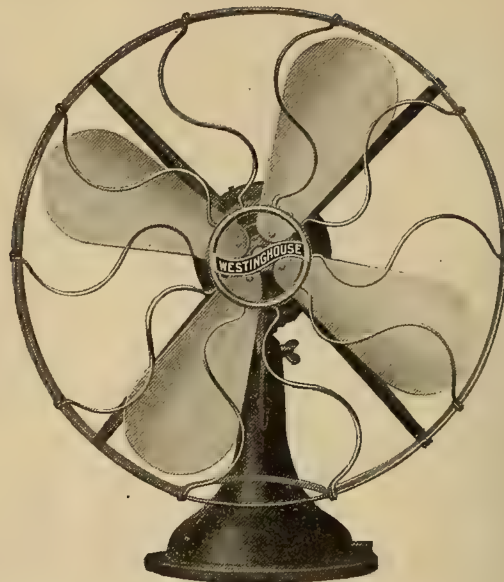
MATERIALS ADVERTISED IN THIS ISSUE

Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**



12-inch Residence Fan



16-inch Desk and Bracket Fan

The Graceful Outlines of

Westinghouse Electric Fans

Drawn-steel frames, a distinct feature of Westinghouse Fans, marked a new era in electric fan construction. It made possible a line of fans not only the most pleasing in outline but 30 per cent lighter in weight.

We have anticipated the 1913 season with larger stocks than ever, and are prepared to make prompt shipments from all important centers. Ask about our attractive contract proposition for Central Stations and Dealers. A condensed list of our leading types follows:

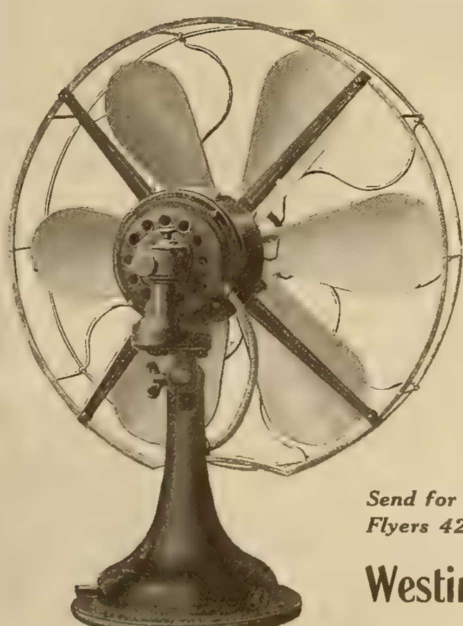
Desk and Bracket	8-inch 12-inch 16-inch
Residence Six-Blade	12-inch 16-inch
Mechanical Oscillating	12-inch 16-inch
Air Operated Oscillating	12-inch 16-inch
Telephone Booth	8-inch
Ceiling	32 & 56 in. A.C. 32, 54 and 57 in. D.C.
Floor and Counter Column	56-inch A.C. 57-inch D.C.
Exhaust Fans	12-inch & 16-inch Blackman Blades 12-in. & 16 in. Westinghouse Blades

Send for Art Circular 1165, Folders 4100 and 4101, Flyers 4232 and 4244, and other advertising helps.

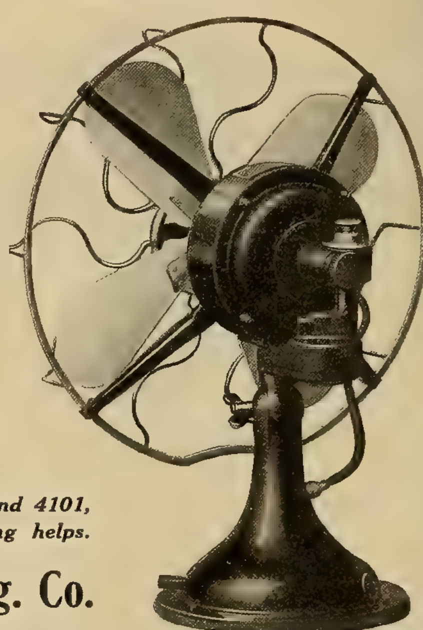
Westinghouse Electric & Mfg. Co.

East Pittsburgh, Pa.

SALES OFFICES IN 45 AMERICAN CITIES



16-inch Mechanically Operated Oscillating Residence Fan



12-inch Mechanically Operated Oscillating Desk and Bracket Fan

JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXX | SAN FRANCISCO, MARCH 15, 1913 | NUMBER 11

ENLARGING THE BEAR RIVER DITCH

BY RUDOLPH W. VAN NORDEN.[1]

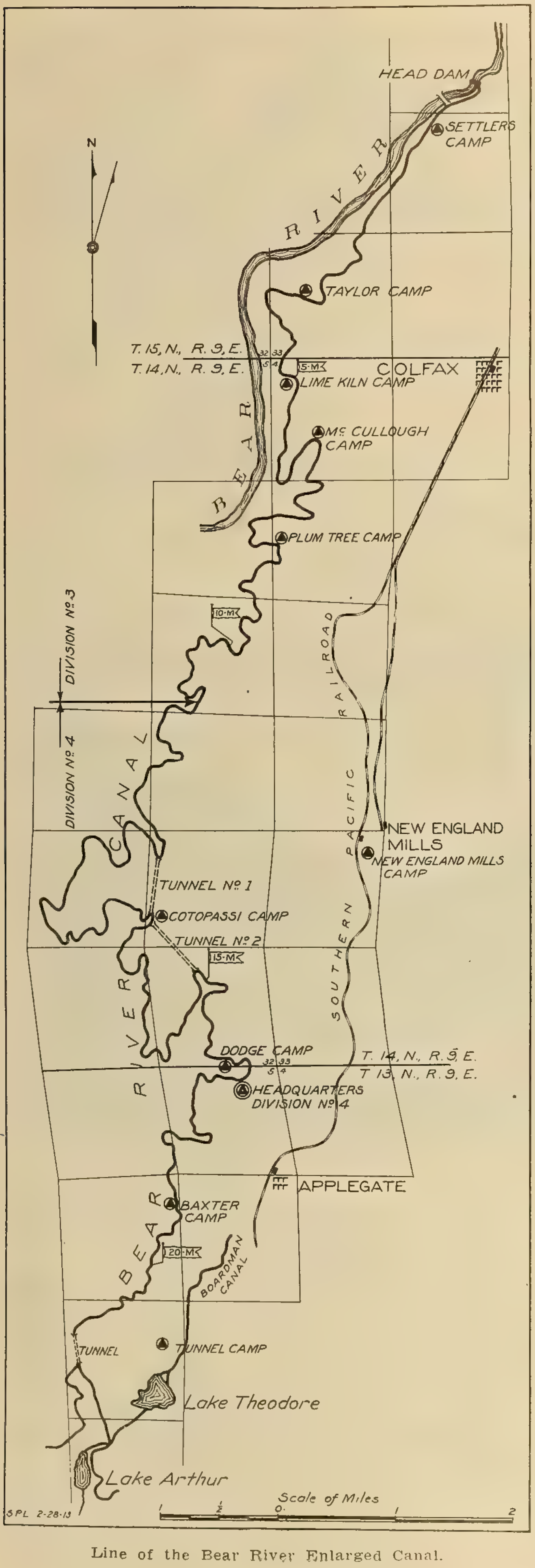
Water ditches or canals in earth are as much a part of California's industrial development as are the highways or bridges or any other works or man indigenous to the country. Since the beginning of water development these ditches have been built, enlarged, rebuilt, and in many cases abandoned, with scarcely as much public notice as might be given by a local news item. To describe, then, as a feat in modern engineering design and construction, the enlargement of 24 miles of an old water ditch must presuppose a work of unusual interest to the engineering world as well as the commonwealth directly benefited.

The enlargement of the Bear River ditch is not only interesting from the design and magnitude of the work and the great power system which it will make possible, but also from the circumstances which throw restrictions about it, hence requiring the greatest skill and ingenuity in its conception and realization.

Briefly, the plan consists in increasing the storage capacity of Lake Spaulding to 4,000,000,000 cu. ft., which will be 15 times its present capacity, by building a new dam 300 ft. high in the gorge of the South Yuba River a short distance below the present dam. Lake Spaulding is now the second largest, and is the receiving lake for the waters of the other 19 lakes of what was formerly the South Yuba Water Company's system, now a part of the Pacific Gas and Electric Company. Water from the new Lake Spaulding will be taken through a tunnel with a capacity of 450 sec. ft. flow and which will contain, near its portal, a single unit power plant of 6500 h.p. maximum capacity, utilizing the static head of the water between the full reservoir and the tunnel level. From this tunnel, water will be carried through a canal 10 miles long to the Drum power plant. This plant will have a capacity of 53,600 h.p., and be located on the south bank of the Bear River. From this point the water is to be taken in a second canal a distance of 8.5 miles to a power plant, now known as No. 2, where a fall of 826 ft. is possible, giving a capacity of 33,250 h.p. Again the water is taken up and carried through a

Head Dam Bear River Canal and Nevada County Narrow Gauge Railroad Viaduct.

[1]Member A. I. E. E., A. S. C. E.



Line of the Bear River Enlarged Canal.

canal a distance of 7 miles to plant No. 3. Here a drop of 500 ft. is possible and a plant capacity of 20,000 h.p. The water from this plant will be discharged into Bear River only to be diverted after flowing in the river about a mile, into the Bear River ditch, the subject of this paper.

It is for the purpose of carrying the increase of 350 sec. ft. from the storage waters in Lake Spaulding that this enlargement is necessary. At a point between Applegate and Clipper Gap, 22.5 miles below the intake (along the new line) there is a drop in the ditch of 340 ft. This forms the site of power house No. 4; it will have a capacity of 13,400 h.p. Continuing to a point near Bowman a receiving and equalizing reservoir, with a capacity of about 400 acre ft., to control the supply of water to power plants 5 and 6 and the irrigation requirement. From here the canal will continue to a point midway between Auburn and Newcastle, where a drop of 530 ft. forms the site for power house No. 5, with a capacity of 20,000 h.p. Again the water is carried in a canal to a point west of the town of Ophir, where a drop into Auburn ravine of 450 ft. gives to power house No. 6 a capacity of 13,400 h.p. Beyond this point the water will be distributed over a territory of 90,000 acres in Placer and Sacramento counties for irrigating the orange and deciduous fruit orchards. The total power plant capacity of the new system will be 160,150 h.p.

The Bear River Ditch.

The South Yuba Water Company's system has two main divisions. This has always been so since its formation by the combination of the South Yuba Canal Company and the Bear River and Auburn Water and Mining Company. These divisions begin geographically with the parting of the ways in Bear Valley, where part of the water which is taken out of the gorge of the South Yuba, below Lake Spaulding, is carried in a ditch and flume along the north wall of Bear Valley and Little Bear Valley, to furnish the supply for the Nevada division and the cities of Grass Valley and Nevada City, while the remainder of the water after passing through Bear Valley is diverted at three points from Bear River to supply the power plants formerly of the Central California Electric Company and the irrigation system.

The first diversion from Bear River is immediately below the lower end of Bear Valley proper and the ditch which carries this water and which follows the south bank of Bear River is known as the Boardman. It is not of interest in this article.

The second diversion is north of the town of Colfax, immediately below the junction of Greenhorn Creek and also the crossing of the Nevada County narrow gauge railroad. This is known as the Bear River ditch; it originally comprised the main canal of the old Bear River and Auburn Water and Mining Company, and is the one to which this description is devoted.

The third diversion is about 16 miles below the second, and supplies water to the western part of Placer County; this is known as the Gold Hill ditch. Like the first, it will not be described.

The original log dam was twice replaced by similar structures. In 1908 the third log dam failed and

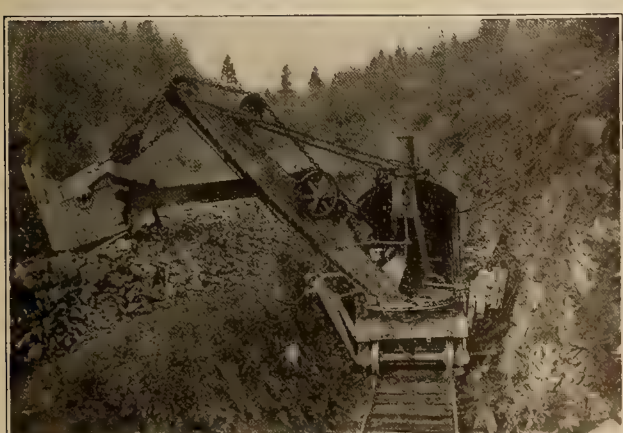
this was replaced during the fall of 1909 by a masonry dam, which was completed December 30th of that year. The new dam was designed and constructed under the direction of the late James H. Wise. It is of cyclopean rubble concrete of gravity section, the downstream face being almost vertical, the foundations being carried to bedrock. The southern end of the dam terminates in a concrete head structure with double sluice gates operated by Crane screw stem standards. Below the gates the outer concrete wall forms an easement weir. This head will be enlarged to accommodate the increased water flow into the enlarged canal.

Plan of Enlargement.

With the work of development at Lake Spaulding well under way the importance of enlarging the system throughout to handle the volume of water which will be liberated by the additional storage becomes a matter of prime importance.

Appearance of Ground After Blasting Ahead of Steam Shovel.

The study of this enlargement was made by the late Mr. James H. Wise as a part of the general plan of development of the South Yuba system. It is undoubtedly the logical method to co-ordinate with the development further up the Bear River.



Marion 1½ Yd. Steam Shovel.

Two factors enter into the problems which govern the work and make its successful outcome, the result of careful organization and good engineering skill. In the first place, this ditch supplies water for irrigation to about 15,000 acres, mostly in deciduous fancy fruits. Any interruption in the supply of water between the first of April and the first of November would be disastrous. Not only would these acres of highly paying orchards be ruined, causing the loss of thousands of dollars to both the orchardists and the company, but the right of personal convenience and necessity would be violated. The problem presented, therefore, to the engineers of the company resolved itself into a study of the economic methods of construction, coupled with a speed sufficient to complete the work of enlargement from a capacity of 1600 miners inches, equal to 40 sec. ft. flow, to a capacity of 14,000 miners inches, or 350 sec. ft., and have water flowing in the canal by April 1st.

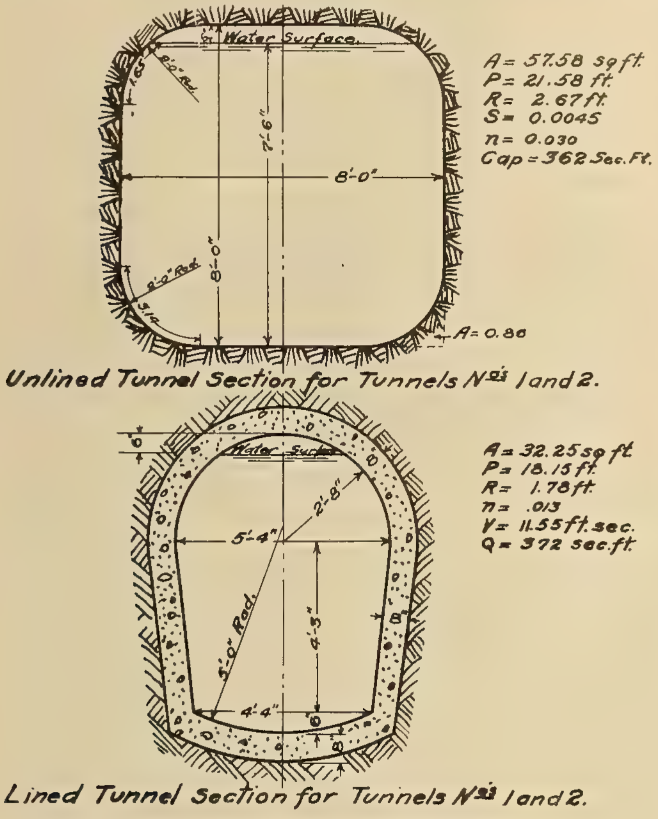
Excavation was actually started on November 9th of last year, which allowed less than five months to complete the work. The canal is, at most points, several miles from the railroad, and can be reached by roads throughout its length in not over a half dozen places. The intervening country is very hilly and the canal itself is, in many places, on forbidding sidehills.

The plan of enlargement is very simple and with but two exceptions of any importance, is a widening and deepening of the old canal and the building of larger and more substantial flumes where it has been found expedient to still use timber flume. The two notable exceptions, where the old canal is not followed is where two long detours or loops are cut out by driving tunnels. Here the work was favored by the fact that the tunnels are almost end to end, there being a distance of but 787 ft. between the outlet of tunnel No. 1 and the upper portal of No. 2. The distance along the old ditch eliminated by these tunnels is 8.6 miles; the length of No. 1 tunnel is 2,112 ft., and of No. 2 is 1,975 ft., or a total length of tunnels of 4,087 ft. equal to 0.77 mile. This subtracted from the total ditch length eliminated, leaves 7.83 miles as the net distance eliminated.

Tunnel No. 1 is practically all in rock, but the second has some timbering. The rock formation is a serpentine common to this section, but is, as a rule, sufficiently homogeneous to be self supporting. Where this is the case, it is not proposed to use any lining and the tunnel section is of sufficient area to pass the full capacity of the canal. This area is 57.58 sq. ft., and the coefficient of roughness, "n" is assumed in calculating the cross section, at 0.030. Where lining is necessary an average thickness of concrete of 8 in. is used, the area of cross-section is reduced below the unlined section of 32.25 sq. ft., and the coefficient of roughness of 0.013 is used. The egg shaped section has been adopted for economic flow conditions, while the square section with rounded corners, for economic excavation.

The tunnels have been driven from four headings each. The ground surface at no place is high above the bore and shafts 85 ft. and 59 ft. deep respectively, were driven near the center point of each tunnel to permit of working each from two extra headings. In the upper portal of No. 1, considerable water was encountered which required pumping. This was accomplished by means of a 3 in. motor driven centrifugal pump, and at the lower portal by a small duplex steam pump, operated by compressed air. An odd condition at the upper

portal made the beginning of this work awkward as the approach to the tunnel is across almost flat ground in which the canal will form a deep trench. As this part of the work had not been completed when the tunnel portal was opened, necessitated raising the muck by a switchback track, and also pumping the water.



Bear River Canal Tunnel Section.

The work of excavation in the tunnels has been rapid, the average work per day from eight headings being about 60 ft. With 150 days to work, it was calculated that a daily average of about 52 ft. would be required. The actual average has been considerably in excess of this calculation.

Work on the tunnels did not start until the middle of December or a month and a half after the time of commencing calculation, but the work in tunnel No. 1 is now almost up to the progress calculation curve and will soon overtake it, while tunnel No. 2, at the present rate of work, will be finished within the time limit.

The tunnel camp, known as the "Cotopassi Camp," is conveniently located between the tunnels and at the forks of a county road. The 60 kilovolt transmission line of the company passes close by, and this is tapped for the power supply at this camp.

The substation is a corrugated iron building containing three 500 kw. Stanley, oil-immersed and water cooled lowering transformers. These are "Y" connected to the 60 kilovolt circuit, the primary winding being 31,213 volts and the secondary, 2490 volts, "delta" connected to the three-phase feeder lines. The motor equipment is all served from a 440 volt three-phase system. In order to obtain this operating voltage, there are installed, one bank of 50 kw., and one bank of 37.5 kw. power transformers wound for 2400 volts primary and 440 volts secondary. Two three-pole 2400 volt oil circuit-breakers complete the equipment. Outside the transformer building, there are mounted a set of pole type disconnecting switches and poletop fuses in glass tubes.

Adjoining the transformer house is the compressor house. This contains one two-stage air compressor, cylinders 16 in. x 12 in., belted to and driven by a 440 volt, 720 r.p.m. General Electric induction motor of 100 h.p. capacity; also one 19 in. x 14 in., two-stage compressor similarly driven by a 150 h.p. motor of same make. The compressors were furnished by the Chicago Pneumatic Tool Company.

The drills used in the tunnels are 3.25 in. Ingersoll-Rand and Sullivan, two drills being used at each heading. Induction motor driven centrifugal blowers placed outside the portals supply air in the tunnels for ventilation.

Below the outlet portal of No. 2 there is a deep cut 425 ft. long which terminates where the old line of canal is joined at the turn of a sharp loop where a gulch was crossed.

The third tunnel on the line is the one which formed part of the old canal. This is being enlarged to practically the dimensions of the other tunnels. For this work a separate compressor camp near Lake Theodore was installed. The substation is 14 ft. x 20 ft. and contains two 100 kw. lowering transformers, the remaining equipment being practically similar to the Cotopassi station. The compressor house has one 12½ x 12 in. Ingersoll-Seargent compressor driven by a 100 h.p. General Electric 440 volt induction motor.

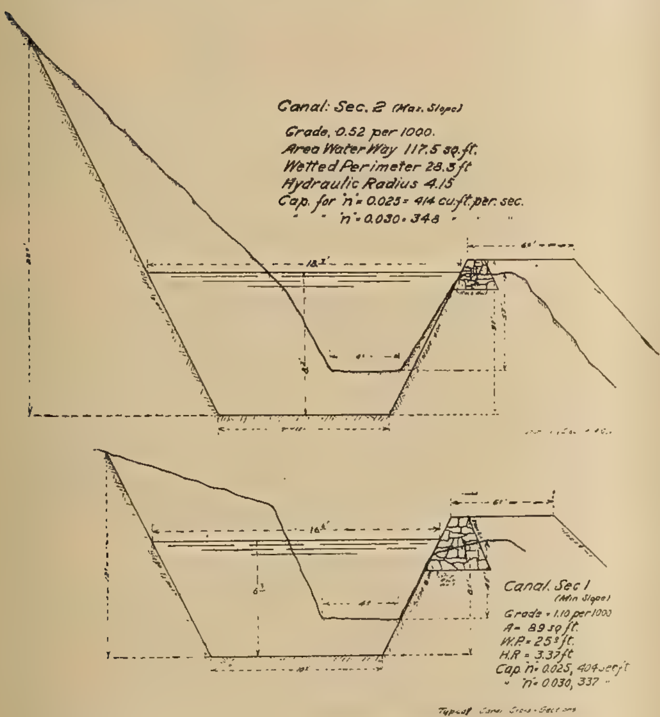
Canal.

The new section of the canal in earth has a trapezoidal section. The bottom width is 10 ft., the width at the berm is 16.6 to 18.3 ft., the depth below the berm is 8 to 9 ft. and the depth of water when running full will be 6.7 to 8.3 ft., all depending upon the grade. The slope of the sides is 1 horizontal to 2 vertical.

Three-Horse Wood Team in Enlarged Canal.

In enlarging, the outer slope of the old ditch is not disturbed, in fact the greatest care has been taken that no shattering of the old berm should take place, this having been proven thoroughly permanent from long use. The new bottom is about 2 ft. below that of the old ditch and the new berm is carried up about 2 ft. aboev the old. Excavation is entirely from the hillside slope and the bottom. The excavation per linear foot of the old ditch was 1.5 to 4 cu. yd., while that of the enlarged canal is 2 to 4 cu. yd. additional.

The latter amount is the net excavation, and this is piled on the old berm. To depend entirely upon banked earth as the outer wall of a canal in earth would be in most cases be disastrous because the action of water and the unavoidable permeability would soon start leaks from which rapid disintegration would result. In building the new berm, after the earth has become well settled from the constant passage along the canal of men and horses, it is cut back, the cut being carried about a foot into the old berm and in this notch is laid a dry rock wall of gravity dam section. Wherever there are soft places in the old ditch wall, this wall is carried to the bottom of the cut. A number of devices have been adopted for reinforcing the outer

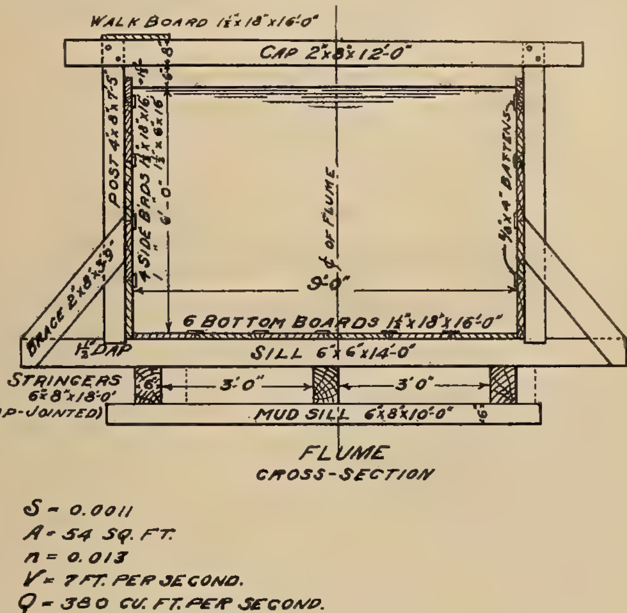


Typical Sections of Old and Enlarged Canal.

berm on curves and places where the outer wall is liable to be weak. In the former instance, at points where the current would cause erosion because of the curve, a timber riprap is used. This consists of sills embedded in the ditch wall, either held by dry rock wall or by concrete. To the sills are spiked heavy planking which receive the force of the current. In a number of cases it has been found advisable, either because of the steepness of the general ground surface, the original thinness of the old berm or for some weakness that might develop, to substitute a concrete wall and lining.

Timber Flume.

The use of timber flume has been very carefully considered, as it is, at best, a construction of high depreciation values. There are, however, often found places where it is economically advisable. In this work, every precaution has been taken in the design and construction of the flumes. The ground surface has been well leveled and cleared above and below to prevent damage from falling trees and rolling rocks. Two sizes of flume have been adopted as standard, the capacity in either case being practically the same. The smaller size used within the first 5½ miles where the grade is 1.1 ft. per 1000. The larger size is used in the next section where the grade is 0.52 ft. per 1000. The smaller flume, of which a section is shown is 9 ft. wide and 6 ft. high inside measurement and contains 1,695.8 ft. B.M. of lumber. The larger flume is 11 ft. wide inside and when up to capacity, runs water 6½ ft. deep. The lumber content is 2,193.33 ft. B.M. The sills, stringers and uprights are heavier than ordinary past practice; the lining is 1½ in. tim-



MATERIAL FOR 16 FT. SECTION						
LUMBER				NAILS		
LOCATION	PCS.	DIMENSIONS	FEET B.M.	NO.	SIZE	NO. LBS.
SIDE & BOT. BDS.	14	1½"x18"x16'	504	140	30 d	7
CAPS	10	2"x8"x12'	160	300	20 d	11
POSTS	5	4"x8"x16'	213.3	400	16 d	9
BOX SILLS	5	6"x6"x14'	210	200	6 d	1
STRINGERS	3	6"x8"x18'	216			
MUD SILLS	5	6"x8"x10'	200			
QUARTER BR.	2½	2"x8"x16'	53.3			
WALK BOARD	1	1½"x18"x16'	36			
SIDE BOARDS	2	1½"x6"x16'	24			
BATTENS	13	⅝"x4"x16'	43.2			
TOTAL, PER BOX			1,659.8			28

Journal of Elect. Pr. & Gas.

Bear River Canal Flume

ber 18 in. wide of clear local pine. The stringers are mounted on mud sills laid on the ground.

Wasteways.

There are seven wasteways installed throughout the length of the canal. These are of concrete and are in reality a concrete lined section of the canal with an outlet, as they preserve the trapezoidal form of the canal. At the outlet, the bottom of the canal is dropped 3 ft., which forms a trap for sand and other debris and prevents the flow in the ditch beyond the wasteway when the gates are opened. The gates are of timber and slide in channel guides and are raised and lowered by a rack and pinion gear. The concrete wing walls and apron are carried far enough away from the canal wall to prevent any possibility of erosion or damage of any kind to the canal during discharge. There is an average of 50 cu. yd. of concrete in each structure, the only reinforcement being at corners and in the arch over the gateway.

(To be continued.)

METHOD OF COMPUTING THE DATA OF A BOILER TEST.

BY J. P. ZIPF.

The best method of presenting the recorded data of a boiler test is by what are known as log sheets. The data is plotted as ordinates against time as abscissae. This has the advantage of showing the relative magnitude of changes as they occur, and the relation of certain events, one with another in a way not possible in a column of figures. We will take the data of an evaporative test on a 2 drum 750 h.p. water tube boiler as an example.

The heating surface is made up as follows:

Tubes	7,123 sq. ft.
Drums	199 sq. ft.
Headers	186 sq. ft.
	7,509 sq. ft. total heating area.

This test was made to determine the efficiency at or near rating. A log sheet of the principal data is shown. All the data is averaged for the period covered by the test. In this article the data will be inserted as needed in the explanation of the computations and marked thus †. The items are numbered, and the numbers in brackets refer to the item corresponding to that number.

†(1) Length of run ....hours.......... 2

†(2) Barometer—inches of mercury.............. 30.2

(3) Barometer—lb. per sq. in. $\frac{(2)}{29.92} \times 14.7 = 14.8$

The gauges had been previously calibrated and the pressures given are the corrected pressures.

†(4) Pressure of saturated steam lb. sq. in......183.0

Z(5) Pressure of superheated steam lb. sq. in....177.7

The drop in pressure through the superheater was 5.3 lb.

(6) The absolute pressure of the superheated steam is (3) + (5) = 192.5 lb. per sq in.

(7) The temperature of saturated steam corresponding to this pressure is ....378.7° F.

†(8) Average temperature of the superheated steam (including the emergent stem correction) .... 435° F.

†(9) Degree of superheat (8) — (7).............. 56.3

†(10) Average temperature of feed water........ 186° F.

From steam tables (Marks & Davis, p. 52)

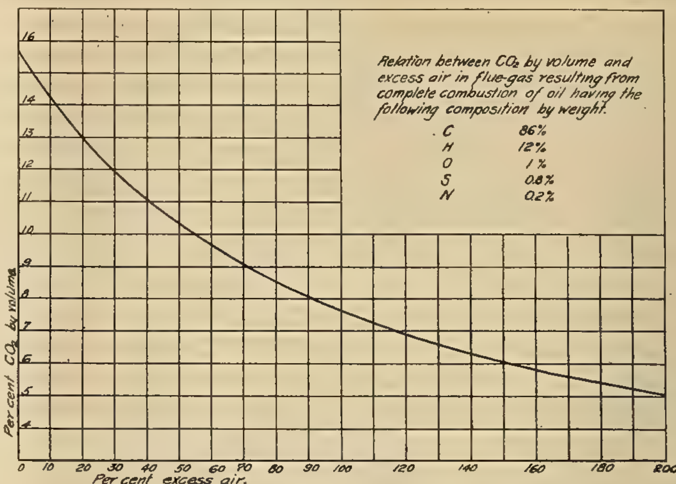
(11) Total heat in one lb. of steam, 192.5 lb. pressure and 56.3° superheat.........1232.4 B.t.u.

(12) Total heat in 1 lb. of feed water (M. & D., p. 11) .... 153 B.t.u.

(13) Total heat input per lb. (11) — (12) = ...1078 B.t.u.

Boilers are rated on their evaporation at atmospheric pressure, or by their ability to supply 970.4 B.t.u. to each lb. of water; 970.4 B.t.u. is just sufficient to transform 1 lb. of water at 212 deg. F. into steam at 212 deg. F., and gives rise to the expression "evaporation from and at 212 deg." (evap. f & a 212 deg.) If in (13) evaporation had taken place from and at $\frac{1078.5}{970.4}$ (or 1.1114) lb. of water evaporated. This factor (1.1114) is called the factor of evaporation, and is expressed by $\frac{H - h}{970.4}$ where H is the total heat in 1 lb. of discharged steam and h the total heat in 1 lb. of entering feed water.

Had the boiler only supplied saturated steam the "quality" of the steam would have been taken.



Relation of Carbon Dioxide and Excess Air

In this test a throttling calorimeter showed an average of .55 per cent moisture in the steam discharged from the drums into the superheater. For each pound of entering feed water there was discharged 0.9945 pounds of steam and 0.0055 lb. of water. The total heat in this case would be made up of the heat in 1 lb. of liquid and the latent heat in .9945 lb. of steam. It is expressed thus:

$$H = (h + xL).$$

where H = total heat in 1 lb. of steam.

h = heat of the liquid at boiler condition.

x = the quality of the steam.

L = latent heat of evaporation.

$H = 351.5 + .9945 \times 845.9 = 1192.6.$

This value is not needed unless it is desired to separate the work of the boiler into two parts: the evaporation of water and the superheating effect,

†(14) Total water weighed ....202,844 lb.

(15) Equivalent evaporation f & a 212° F. = (14) × factor of evaporation ....224,440 lb.

(16) Average hourly rate (14) ÷ (1)......... 25,355 lb.

(17) Average hourly equivalent evaporation (16) ÷ (1) .... 28,180 lb.

1 boiler h.p. requires an evaporation f & a 212° of 34.5 lb. of water per hour, hence

(18) Power developed (17) ÷ 34.5........... 817 b.h.p.

(19) Builders' rating .... 750 b.h.p.

(20) Per cent of rating developed 100 × (18) ÷ (19) .... 108.7 %

The average hourly rate is shown on the log sheet curve.

(21) Total oil consumed .... 15,107 lb.

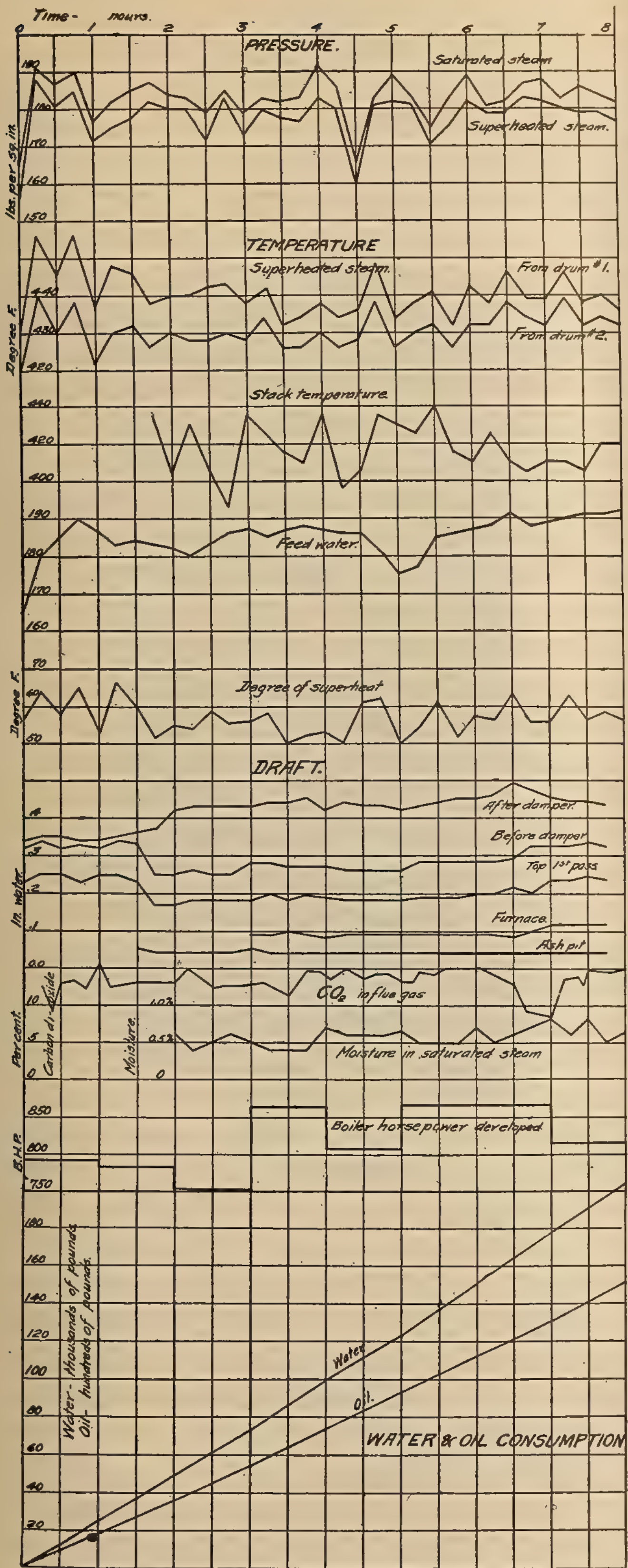
(22) Per cent of moisture in the oil............... 1.0 %

Fuel consumption corrected for moisture (21) ×] 1.00 — (22)]........... 14,956 lb.

(23) Average hourly rate—oil as fired........ 1,888.4 lb.

(24) Average hourly rate,—oil corrected for moisture .... 1,869.5 lb.

(25) Gravity of the oil....................... 15.2 °Be.



Typical Boiler Test Log Sheet.

(26) Calorific value of oil free from moisture B.t.u. per lb. 185.84
The economic results of a boiler test are expressed as evaporation per lb. of oil.

(27) Actual evaporation per lb. of oil as fired (16) ÷ (23) .... 13.42 lb.

(28) Evaporation f & a 212° per lb. of oil as fired (17) ÷ (23) .... 12.42 lb.

(29) Evaporation f & a 212° per lb. of dry oil (17) ÷ (24) .... 15.06 lb.

(30) The heat output of the boiler as steam per lb. of dry oil (29) × 970.4.... 14,690 B.t.u.

(31) Gross boiler efficiency (30) ÷ (26)...... 18.65 %

(32) Steam supplied to burners per lb. of oil (estimated) 5

(33) Oil fired per minute (23) ÷ 60......... 31.4 lb.

(34) Steam used for atomization per minute (32) × (33) .... 15.7 lb.

(35) Water evaporated per minute (16) ÷ 60.. 422.6 lb.

(36) Per cent of steam used by burners (34) ÷ (35) .... 3.72 %

The net efficiency is the ratio of the heat taken away in the net steam output to the heat per lb of dry oil.

The net quantity of steam per lb. of oil as fired is (27) — (32) = 12.92 lb.

This would represent a heat output of 12.92 × 970.4 × factor of evaporation or 13,934 B.t.u.

The efficiency is then 13,934 ÷ [(26) × 1.00 — (22)], since the heat output is based on oil as fired, and the calorific value of the fuel is given for dry oil.

(37) Net efficiency ....% 75.76

†(38) Average CO_2 ....% by volume 12.2

Sufficient data for a heat balance was not taken but the method of making a heat balance was outlined in the Journal, November 18, 1911. The carbon dioxide present indicates about 18 per cent excess air. This is obtained from the curve showing the relation between excess air and CO_2 by volume for an average California crude oil. This curve is due to Mr. R. F. Chevalier. An approximate heat balance for 1 lb. of fuel can be made as follows:

There is theoretically required for combustion about 14 lbs. of air for 1 lb. of fuel. As there is here 18 per cent excess air the total weight of the gas is 1 + (14) × (1.18) = 17.5 lb.

†(38) Average stack temperature .... 420° F

(39) Average external air (assumed).............. 80° F.

If the oil contains 12 per cent of hydrogen (H) as given on the curve for an average California oil there will be 9 H (or 1.08) lb. of water formed. There will then be 17.5 — 1.08 = 16.42 lb. of dry flue gas. Five-tenths lb. of steam were used to atomize 1 lb. of oil, hence for each lb. of fuel 1.08 + 0.50 (or 1.58) lb. of water vapor is included in the flue gas. One lb. of oil as fired contains .99 × 18,584. or 18,397 B.t.u.

	B.t.u.	%
Heat carried away in steam (13) × (27) = ...	14,473	= 78.67
Heat carried away in dry flue gas 16.42 × [(38) — (39)] × .24 = ...	1,341	7.29
Heat carried away in water vapor 1.58 [1150.4 — 48.0 + (38) — 212.48] = ...	1,900	10.32
Radiation and other losses unaccounted for....	683	3.72
Heat in 1 lb. of fuel as fired..................	18,397	100.00

The boiler efficiency is always referred to moisture free oil, but the heat balance, being a summary of actual items, is based on oil as fired.

All losses unaccounted for are included as radiation, which remains after all measureable losses are subtracted from the heat value of the oil.

ELECTRICAL PUMPING AND IRRIGATION

DETAILS AND DESIGN OF HEADGATES.

BY B. A. ETCHEVERRY.

Gate lifting device. When either opening or closing a gate, the lifting force must overcome the sum of the friction produced by the pressure on the grooves of the weight of the gate. The starting force must be equal to the coefficient of static friction multiplied by the pressure. The coefficient of kinetic friction is less than the static coefficient; it diminishes gradually with an increase of speed. The following table gives the coefficients of static friction applicable to gate bearings not lubricated.

Coefficient of Static Friction.

Timber on timber	0.5	to 0.2
Metal on metals	0.25	to 0.12
Timber on metal	0.6	to 0.2

	Lbs. per sq. in.
Wrought iron on wrought iron, 0.25 for pressure of	187
Wrought iron on wrought iron, 0.41 for pressure of	560
Wrought iron on cast iron, 0.28 for pressure of	187
Wrought iron on cast iron, 0.37 for pressure of	560
Steel on cast iron, 0.30 for pressure of	187
Steel on cast iron, 0.36 for pressure of	560
Brass on cast iron, 0.23 for pressure of	187
Brass on cast iron, 0.23 for pressure of	560

The lifting device must be so designed and fastened to the operating platform that a force can be exerted to close the gate as well as to open it.

The gate lifting devices can be classified according to the mechanical principle on which their action depends. They are represented by three general classes of machines: (1) the lever; (2) the inclined plane; (3) the cord or pulley. Each of these classes includes a number of different types of gate lifting devices. The following are most commonly used:

I. Lever class.
- a. Simple lever.
- b. Wheel and axle or windlass.
- c. Rack and pinion with operating arm.
- d. Rack with multiple gears and operating arm.

II. Inclined plane class.
- a. Threaded gate stem and operating wheel.
- b. Threaded gate stem, main geared wheel, worm and operating arm.

III. Pulley class.
- a. Simple pulley.
- b. Differential pulley.
- a. Gate stem, main bevel-geared wheel, bevel-

IV. Lever combined with inclined plane or gearing.
geared pinion and operating arm.

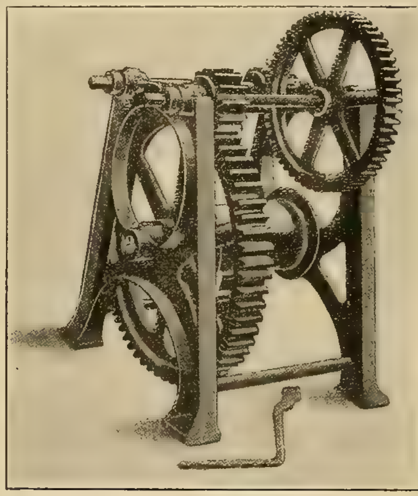
I. Lever class.

The **simple lever** requires that a frame be built to support a top horizontal piece near the face of the gate stem at a height of about 3 ft. from the floor. For a wooden structure this is usually done by extending the vertical posts which form the grooves of the gate, and placing a cap on top of the post. The force is applied to the gate stem by supporting the lever on a fulcrum. The fulcrum is preferably formed by bolting a metal bar to it. Two fulcrums are generally necessary; one to raise the gate and the other to force it shut.

A cheap form of lifting frame for a concrete structure is to imbed in the concrete vertical posts made of 1 or 2 in. wrought iron pipe extending about 3 ft. above the operating floor and connected at the top by means of elbows, to a horizontal piece of pipe which will serve for the fulcrums.

The gate stem, if of wood, is usually strengthened by a metal band, bolted to it, and with holes 2 in. apart into which one end of the lever is inserted. Necessary details for locking the gate in position must be provided. This type of lifting device is simple but is only applicable to smaller structures and where the required lifting force is not very great.

Wheel and axle or windlass. A windlass requires an axle to which the gate is connected by means of chains or ropes and an operating wheel or arm fastened to one end of the axle. It may be either a traveling winch which can be moved from one gate



Gate-Lifting Windlass.

to the next, or a stationary one. In the second case the axle is placed above the gate and may be used for more than one gate by extending it above the other gates; the gates may be lifted either together or singly.

The axle must be at a height of about 3 ft. above the operating platform. A simple frame to support the axle can be made of iron pipe. This will consist of two or more posts made of pipe with the lower end fastened to the operating platform or buttress walls and the upper ends threaded and extending about 3 ft. above the floor. Tees screwed on to the upper ends will form the bearings for the axle. The axle will be a smaller size pipe, which fits in the tees. The operating arm is connected by means of an elbow screwed to the threaded end of the axle.

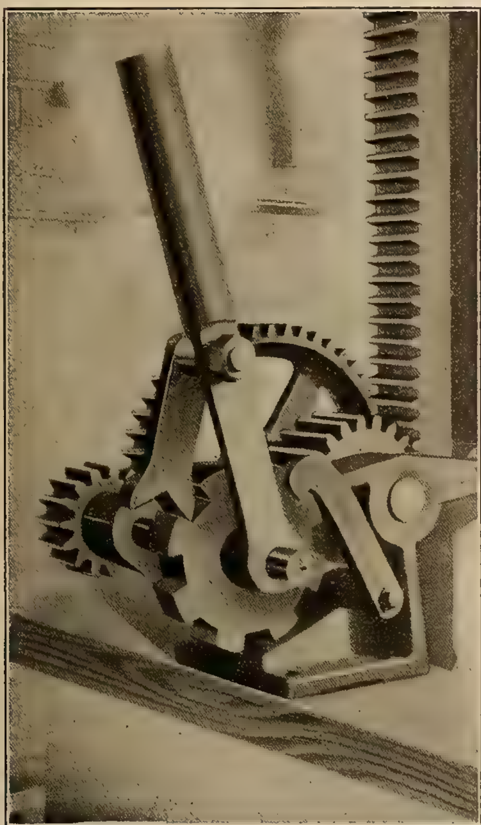
The mechanical advantage is equal to the length of the operating arm divided by the radius of the axle. If

P = total pull necessary to lift the gate.
F = operating force.
r = radius of axle.
R = length of operating arm or radius of operating wheel;

then, $F = \dfrac{Pr}{R}$

This type of device is only used where the pressure on the gate is not very great, and where it is not necessary to exert a downward force to close the gate.

Rack and pinion with operating arm. This device consists of a rack fastened to the gate stem, a geared pinion to transmit the force to the rack and an operating wheel or arm connected to the same



Rack With Multiple Gear for Lifting Gate.

axle as the pinion. The force is applied to the operating wheel, the fulcrum is at the center of the wheel and pinion and the pull acts at the rack. If

P = total pull.
F = operating force.
R = length of operating arm.
n = number of gear teeth in pinion.
p = pitch of gear teeth on rack or pinion.

then, if the efficiency of the gears is e, the work equation is

$$npP = e \times F \times 2\pi R$$
$$\text{or } F = npP/2\pi Re$$

If r = diameter on pitch line of pinion, then $np = 2r$, and $F = Pr/Re$. The efficiency of spur gear with teeth cast is about 93 per cent and with teeth cut, 96 per cent. A rack and pionion lifting device is preferable to a windlass when it is necessary to force a gate down.

Rack with multiple gears and operating arm. This consists of the simple rack and pinion with additional gears to give greater mechanical advantage. For a triple geared rack the relation between the operating force and the total pull is obtained as follows:

Let F = operating force at end of operating arm.
F_1 = force exerted by first pinion on main geared wheel.
P = force exerted by second pinion on rack or total pull on gate.
R = length of operating arm.
r = radius of pinion connected to same axis as operating arm.
R_1 = radius of main geared wheel.
r_1 = radius of pinion acting on rack.
e = efficiency (93 per cent for cast teeth, 96 per cent for cut teeth).

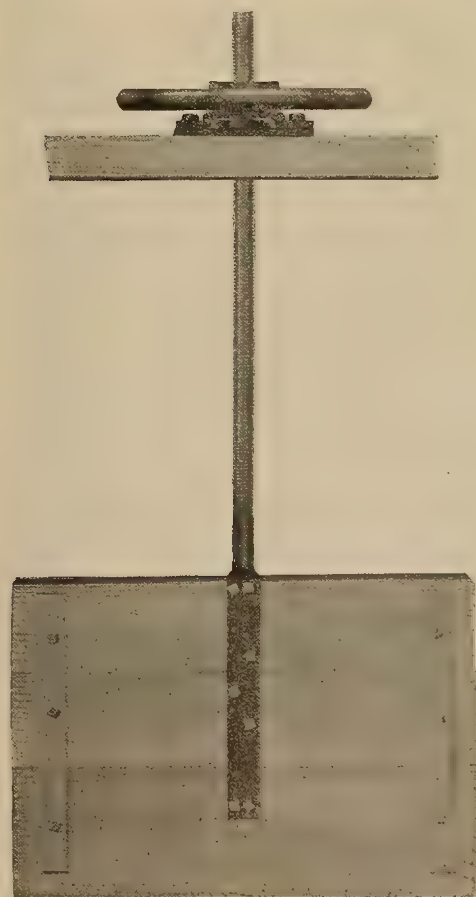
The work equations are:

$$F = \frac{F_1 r}{Re} \quad F_1 = \frac{Pr_1}{R_1 e} \quad F = \frac{Prr_1}{e^2 RR_1}$$

A multiple rack is used where it is desired to overcome a larger force than can be conveniently done with a simple rack; in which case it has no special advantage over a threaded gate stem and operating wheel which is usually less expensive.

II. Inclined plane class.

Threaded gate stem and operating wheel. This is the simplest device of this class. The lower end of the gate stem is connected to the gate and the upper end is threaded and screws in the operating wheel. The operating wheel is either supported on a beam above the gates or is part of the operating stand. When lifting the gate the wheel presses down



Threaded Gate Stem and Operating Wheel.

on the beam, but when lowering the gate unless its weight is sufficient to overcome the friction a force is exerted upwards on the beam and to force the gate shut the operating wheel must be either held down to the beam or a second wheel placed on the under side of the beam. The former arrangement is usually preferable for large gates. To decrease wear and friction the bearing surfaces are usually made

of different materials. A flanged nut of phosphor bronze with threads to match the threads of the gate stem, is inserted in the center of the operating wheel and keyed to it. The flange of the nut is on the under side of the gate and bears on a brass seat. A brass cover plate placed over the flange and bolted to the beam will hold the wheel down and form the seat for an upward force. To further decrease the friction ball bearings may be used.

Typical Design of Steel Gate.

The gate stem may be made from a solid steel axle or from heavy pipe. It must be designed not only for tension but for torsion and compression. The minimum diameter in practice is about 1 in. The number of threads per inch is generally 3 or 4. The size of the operating wheel will vary with the power desired. For one revolution of the wheel the gate is raised an amount equal to the pitch. The work equation is as follows:

Let P = total pull on gate.
p = pitch of threads.
R = radius of operating wheel
F = operating force.
e = efficiency of device. The efficiency, which is the combined efficiency of the screw and of the seat may be taken as about 25 per cent.

$$pP = e\,2\pi RF$$

$$F = \frac{pP}{e\,2\pi R}$$

Threaded gate stem, main geared wheel, worm and operating arm. This device is used where a more powerful machine is wanted. It consists of the threaded gate stem, the main geared wheel which has the same relation to the gate stem as the operating wheel described above, the worm or endless screw which acts on the gears of the wheel and an operating

Operating, Arm Worm, Main-geared Wheel, and Threaded Gate Stem Lifting Device.

arm connected to the worm. The machinery is generally assembled on a cast iron stand which can be bolted to the operating floor. One revolution of the arm gives a revolution to the worm which moves the main geared wheel through the pitch of the threads of the worm. The relation between the operating force and the total pull is given by the following equations:

p = pitch of threads on gate stem.
p_1 = pitch of threads on worm.
R_1 = radius of pitch line on main geared wheel.
R = Radius of operating arm.
P = total pull on gate.
F = operating force.
F_1 = force exerted between worm and geared wheel.
e_1 = efficiency of worm = about 50 per cent.
e_2 = efficiency of screw stem = about 25 per cent.

$$2\pi RFe_1 = F_1 p_1 \qquad (1)$$

$$2\pi R_1 F_1 e_2 = Pp \qquad (2)$$

From (2) $F_1 = \frac{Pp}{2\pi R_1 e_2}$ which substituted for F_1 in (1) gives $F = \frac{Pp\,p_1}{4\pi^2 R R_1 e_1 e_2}$

$$F = \frac{Pp\,p_1}{5\pi^2 R R_1} = \frac{2P\,p_1\,p}{\pi^2 R R_1}$$

III. Pulley class.

A **simple pulley** lifting device would consist of one block fixed to the operating frame, built above the gate, a second block fixed to the gate, and the connecting ropes. The blocks may have single sheaves or multiple sheaves which revolve independently. As there are two ropes to each sheave, the operating force will equal to the total pull on gate divided by two times the number of sheaves.

Let F = operating force.
P = total pull on gate.
n = number of sheaves in each block.

$$\text{then } F = \frac{P}{2n}$$

Simple pulleys are seldom used. Their mechanical advantage is small so that they can only be used for small gates under low heads.

A **differential pulley** device would be similar to simple pulley device except that the upper pulley is a block made of two sheaves of different radii, fixed

Stand for Operating Wheel and Threaded Gate Stem Lifting Device.

to each other so as to rotate as one piece about a fixed axis. The lower pulley is a single sheave block whose radius is a mean of the radii of the upper pulley.

Stand for Bevel-Geared Lighting Device.

The rims of the pulleys are shaped to hold an endless chain which passes over the three sheaves.

Let R = radius of larger sheave of upper pulley.
r = radius of smaller sheave of upper pulley.

R_1 = radius of sheave of lower pulley $= \dfrac{R+r}{2}$

F = lifting force.
P = total pull on gate.

$$\text{Then } F 2\pi R = P\,(2\pi R_1 - 2\pi r)$$

$$FR = P\,(R_1 - r)$$

$$\text{or } FR = P\,(\frac{R + r\ 2r}{2}) = \frac{P}{2}\,(R - r)$$

$$F = \frac{P}{2R}\,(R - r)$$

IV. Combined lever and inclined plane or gearing.

The device of this class used generally consists of the gate stem, a horizontal main bevel-geared wheel, a vertical bevel-geared pinion and an operating arm or wheel connected to the pinion. The machinery is generally assembled on a cast iron operating stand. The gears are of steel and the bearings for the gate stem and main geared wheel are made as for the simple gate stem and operating wheel device described above.

Let R = radius of operating wheel or length of operating arm.
r = radius of pitch line of pinion.
R_1 = radius of pitch line of main bevel-geared wheel.
p = pitch of threads on gate stem.
F = operating force.
F_1 = force exerted between geared wheels.
P = total pull on gate.
e_1 = efficiency of bevel gears: 92 per cent for cut teeth; 96 per cent for cast teeth.
e_2 = efficiency of screw stem: about 25 per cent.

$$\text{Then, } e_1 2\pi RF = 2\pi r F_1 \ldots\ldots\ldots (1)$$

$$e_2 2\pi R_1 F_1 = pP \ldots\ldots\ldots (2)$$

$$\text{From (2) } F_1 = \frac{pP}{e_2 2\pi R_1} \ldots\ldots\ldots (3)$$

Substitute (3) in (1)

$$e_1 2\pi RF = \frac{2\pi r p P}{e_2 2\pi R_1}$$

$$\text{or } F = \frac{pPr}{e_2 e_1 2\pi R R_1}$$

INTERESTING FACTS ABOUT CHILE.

Chile, which on the map appears to be 2000 miles long and about 2 inches broad, extends from 7° 47′ southward to Cape Horn, and measures more than 2500 miles in length, while the breadth of the territory from the Andes to the Pacific varies from 100 to 180 miles.

The real wealth of Chile depends, of course, on her rich soil, valuable climate and the vigor and industry of her proletariat (working people). But though there is a considerable export in agricultural produce, and although the government seems fully to realize that agriculture and colonization must be encouraged and carefully fostered by every means, yet it is to the nitrates and mining products that the present wealth of Chile is due. It is the export duty on nitrates that keeps Chile prosperous and flourishing.

There is no opportunity in Chile for the British workman. No European could compete in manual labor with the frugal Chileno. But a master-workman with a little capital, or indeed, any man with business enterprise, thorough knowledge of his profession, and from $1000 to $4000, ought to find his opportunity. Certainly the chances are infinitely more favorable than any which he is likely to obtain at home. But he should work for some one else in Chile for at least two years before launching out on his own account.

PURIFICATION OF GAS.[1]

BY E. C. JONES.

This subject is intended to cover the treatment of coal gas from the hydraulic main to the station meter, and includes condensation, scrubbing and washing, as well as what is strictly termed purification.

The temperature of the retort in which coal is distilled is usually above 2000 degrees F., and the temperature of the gas only a few feet away from the retort is 125 degrees F. Five cubic feet of purified gas at normal temperature has a volume equal to about 390 times that of the pound of coal from which it was made. This gas as it leaves the retort in a crude state, is expanded in volume by the vapors of gas liquor and tar, as well as the other impurities removable by purification. The crude gas is also in an expanded condition on account of its temperature above normal. This amounts to 13.2 per cent of its volume for expansion between 60 degrees F. normal and 125 degrees F. its temperature before entering the hydraulic main.

Gas is expanded by heat 1/491.4 for each degree, or about 1 per cent for every five degrees F.

Nothing but coke remains in the retorts, so that the hot gas leaving the retort contains all the tar and ammoniacal liquor distilled from the coal and held in suspension in the form of fog and vapor. The amount of these substances so held depends on the heat of the gas, so that when the gas enters the hydraulic main there is a considerable drop in temperature and the heavier portion of the tar and ammoniacal liquor is deposited in the hydraulic main, and in turn flows to the tar well. The piece of apparatus next in sequence to the hydraulic main is the exhauster. This machine is best explained by calling it a rotary gas pump, and it performs the double duty of drawing the gas from the hydraulic main, (and it is from this work that it received the name exhauster) relieving the back pressure on the retorts, and at the same time exerts pressure at the outlet to force the gas through the condensers, scrubbers, and purifiers.

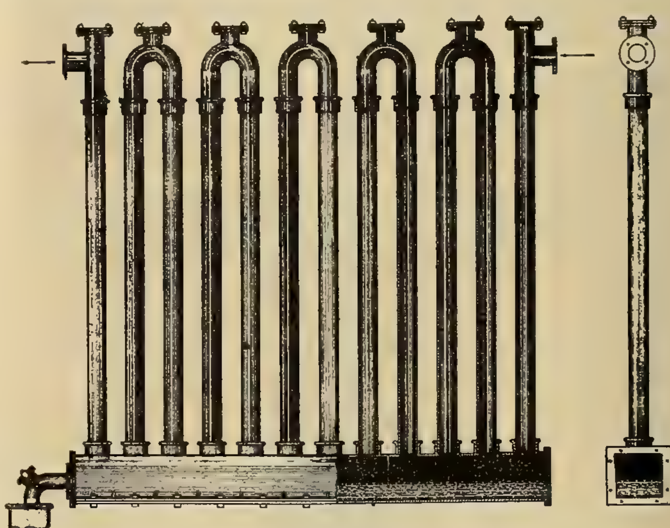
It is difficult and quite unsatisfactory to attempt to describe by words the construction of even simple machinery, and reference to diagrams and models will give a much better understanding of gas works apparatus.

The first rotary exhauster was invented by Beale in England, and it was afterwards much improved by P. W. Mackenzie of New York. The Roots exhauster is probably most generally used in gas works of today. This machine consists of two impellers shaped like the figure 8. These are set on parallel shafts at a pitch of 90 degrees, so that one swings within the other, and are enclosed in an iron case with inlet and outlet pipes on opposite sides.

Exhausters are usually operated by steam engines, either direct connected or belt driven. In many gas works the exhauster is located beyond the condenser, but when it is so placed it requires so much lubrication that it became a source of trouble. When it is placed between the hydraulic main and the condenser it requires no internal lublication, and if allowance is made in the construction of the exhauster for expansion, due to pumping hot gas, it works most satisfactorily. The exhauster at this point also performs a certain amount of mechanical scrubbing by breaking up and depositing tar globules. Another and perhaps the best reason for placing the exhauster immediately after the hydraulic main is that all condensing and scrubbing apparatus is operated under pressure. Experience teaches that it is better that gas shall leak out of such apparatus than to have air drawn in.

The function of the gas condenser is to gradually, and without shock, reduce the temperature of gas to nearly the local normal temperature of the air. In thinking of gas it must not be considered as a fixed chemical substance, but as a physical mixture of gases of different densities. At the hydraulic main every part of the coal, excepting the coke, is in the form of gas heavily charged with water and hydrocarbon vapor. Some of these vapors are deposited in the hydraulic main; and the foul main encircling the retort house, and more of them in the condenser, and the amount of volatile hydrocarbon deposited or remaining in the gas is simply a question of vapor tension due to temperature.

The vapor tension increases with a rise of temperature and decreases with a fall of temperature. The treatment of the gas in the condenser and scrubber should therefore be such that the gas will become stable, and retain its illuminants at local normal temperature. This differs with the seasons of the year and at different latitudes.



Early Form of Multitubular Condenser for Coal Gas.

The simplest and first form of condenser was a series of upright, round pipes, fitted into a cast iron base and connected at the top by return bends. The base contained partitions extending nearly to the bottom, between each pair of upright pipes. This provided a great length of condensing tubes in a small space, and the condensed tar and ammoniacal liquor flowed downward on the inside surface of the upright pipes into the base and thence to the tar well. Condensation in this apparatus is accomplished by the radiation of heat through the pipes, and is assisted by the frictional scrubbing of the gas on the inside

[1]A lecture delivered before the students in the new Gas Engineering course at the University of California.

surface of the pipes and in changing its direction of flow through the condenser.

Clegg claimed that "when ordinary vertical iron pipes, radiating in air are used, the portion of the gas in the center is not brought into contact with the exterior and cannot be effectively cooled." Many new forms of apparatus have grown out of this simple multi-tubular condenser, some vertical and some horizontal, while others increase the frictional area and length of passage by using flat sinuous tubes in place of round pipes.

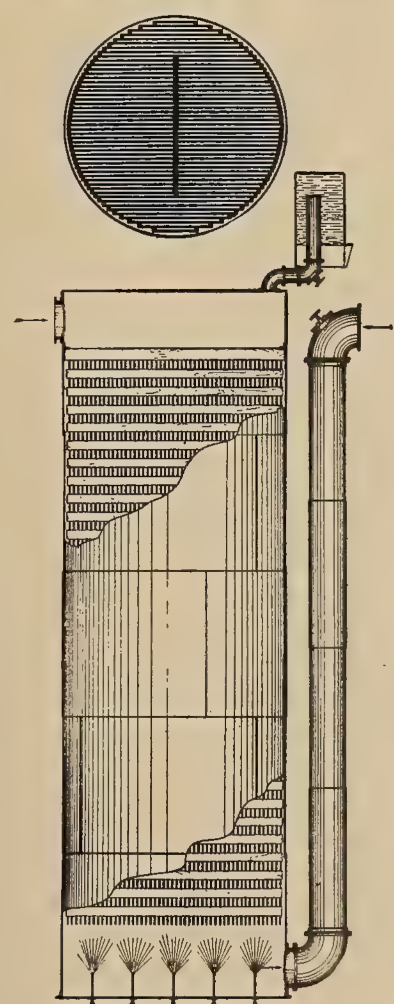
Another type of condenser consisted of a series of large upright pipes, one within the other. This was known as the annular condenser. The inner tubes were open to the air at both ends, while the outer tubes were connected together at the top and bottom in regular sequence. The gas passed through the annular space between the pipes and a current of air was drawn through the inner pipes. These condensers were usually made of wrought iron, on account of the comparatively thin walls of the pipes there was a greater radiation of heat. In warm weather it often became necessary to have a spray of water in the inner tubes to assist in the cooling of the gas.

These types of condensers were easily clogged by stoppages of thick tar and pitch, and it was difficult to clean them. All condensers depending on air radiation to reduce the temperature of the gas, are subject to climatic changes hourly, daily, and seasonally, without means of regulation. The condenser now generally used as a primary condenser in coal gas works, is an upright steel shell cylindrical in form, and containing a large number of boiler tubes, expanded into tube sheets placed near the top and bottom of the outer shell. The gas inlet is at the side above the upper tube sheet, and the outlet is at the side below the lower tube sheet. In this form of condenser the gas flows through the tubes, and the space around the tubes is filled with water. To avoid sudden cooling of the gas, the water inlet is at the bottom where the gas is at its lowest temperature, and the water outlet is at the top, so that the heated water comes in contact with the tubes where the gas is hottest. With a condenser of this type of ample capacity, the temperature of the gas may be gradually reduced, and any variations in volume of gas, or changes in atmospheric heat, may be compensated for by regulating the flow of water around the tubes.

Condensation removes the tar fog, tar vapor, and ammoniacal liquor held in suspension; and these flow together from the base of the condenser, through a sealed drip-pot to the tar separator, where owing to the difference between the specific gravity of tar and ammoniacal liquor there is a separation and each flows to its own storage well.

In modern coal gas works, what is known as a foul main receives the gas from the hydraulic main and conveys it to the exhauster. This is usually a large sheet steel pipe suspended to the walls of the retort house, and acts as a condenser and at the same time some of the naphthalene in the gas is absorbed by passing over the condensed tar. In some works a simple tar scrubber either takes the place of the foul main, or is supplementary to it. The tar scrubber removes a portion of the naphthalene, and the tar gives up some of its benzol to the gas, adding somewhat to its candle power. After the condensers, it is customary to pass the gas through a tower scrubber for the purpose of removing any tar remaining in it, and for the extraction of ammonia by water scrubbing.

The first tower scrubbers were filled with gas coke in deep layers resting on wooden trays. This material was taken from stock always at hand, and proved efficacious as a filtering material. It had the troublesome disadvantage of becoming clogged with tar and causing back pressure. This required frequent changing and it often happened at inopportune times. The coke after being used in the scrubber was again used as boiler fuel. Probably the best form of scrubber is an upright steel shell filled with wooden trays, or grids, made by spacing boards on edge in sections which completely fill the shell; each section being placed at right angles to the one immediately above and below it. Water is sprayed over these trays at the top, and flows downward through the trays and overflows at the bottom into a sealed drip-pot. The gas inlet is at the bottom below the trays, and the gas outlet is at the top above the trays. In this manner a large area of wet surface is presented to the gas with a minimum use



Modern Scrubber for Coal, Water or Oil Gas.

of water. The ammonia in the gas, which is not condensed as gas liquor in the hydraulic main and condensers, is removed by water in the scrubber and washers, and the temperature of the gas is still further reduced. To completely remove ammonia by absorption by water, it is necessary to reduce the temperature of the gas to 60 degrees F.

The scrubber water flows to the ammoniacal liquor well, and as this liquor is a valuable by-product great care is used in saving it, and it is then pumped back to the scrubber and is used over and over until it has reached a marketable strength.

The final treatment of the gas for the removal of ammonia is by passing the gas through a rotary washer, consisting of a number of circular discs fastened to a revolving shaft in a cast iron case. These discs are made of thin sheets of iron spaced about ⅛ in. apart; and each disc revolves in a separate compartment. Gas enters the washer at one end, and after passing between the sheets of iron in the discs, passes out at the other end. These discs are sometimes made of wood. The compartments are so arranged that there is a different water level in each one, this is accomplished by having a slightly lower overflow opening in each succeeding compartment. Fresh water is admitted to the upper or gas outlet end of the washer, and flows slowly through to the lowest overflow, filling all the compartments. These discs revolving in the water are constantly presenting freshly wetted surfaces to the passage of the gas.

(To be continued.)

PROPOSED INVESTIGATIONS FOR INDUCTIVE INTERFERENCE.

Early in the official life of the present Railroad Commission of the State of California many cases of inductive interference between the power lines and the lines of communication systems were brought up for official settlement. It was found that comparatively little is known accurately as to the quantitative effect of different factors on the disturbances in communication circuits, although a great deal of theory of induction phenomena has been worked out. It was felt that if the question could be discussed at length some valuable results might be obtained which would assist the commission in determining under what conditions parallels between high tension power lines and communication lines are permissible, and in issuing regulations governing thereafter the construction and operation of such lines in proximity to each other, so that the inductive interferences common to such parallelism could be minimized. Accordingly the Railroad Commission early in December, 1912, invited companies owning and operating electric power lines and telephone and telegraph lines in the State of California to meet informally and discuss the question of appointing committees representative of the many interests concerned, to form an organized investigating board, which, together with representatives of the commission, should constitute a joint committee empowered by the Railroad Commission to conduct tests and experiments, the results of which should serve as a basis for future regulations of the commission.

The conference met December 16, 1912. Four representatives were selected by the power interests, four by the communication interests, one by the railroad interests, and four were appointed by the commission. At a subsequent meeting the joint committee was increased by the selection of one more representative of the power interests and one of the communication interests, making a total of fifteen. The committee organized under the name of The Joint Committee on Inductive Interference by the election of a chairman, a secretary and a treasurer, and by the appointment of sub-committees on ways and means, finance, transportation, program, and publicity, as permanent committees, and by the appointment of a committee to supervise and to analyze the results of tests.

Assistance from the power, telegraph, and telephone companies in the shape of money contributions and from the railway companies in the shape of transportation for men and apparatus was requested. All of the companies interested in the work were requested to assist by furnishing such men and apparatus as might be available for the work, and by permitting the committee to use the communication and power lines for tests to be made at such times that they would not interefere with the public service. All parties concerned in the investigation have joined in the most liberal manner to meet these requests.

Already some work had been done by the Pacific Telephone & Telegraph Company and the Coast Counties Gas & Electric Company in an investigation of a parallel in Santa Clara Valley. A sub-committee was appointed to complete the work on this parallel, and their jurisdiction was extended over the second proposed series of tests at Salinas.

Since one of the reports of the test committee outlines essentially the method used in making both the first and the second series of tests, the folowing extracts are quoted from it:

Method of Making Tests.

In the following paragraphs are outlined the tests which are to be made on the communication circuits and power circuits for each condition of the power line.

A—Tests on Telephone Circuits:

The tests on telephone circuits are designed to give quantitative information regarding the total effect of the power lines on the telephone circuits and also regarding the effect of each harmonic in the power system on the telephone circuits.

The tests which are outlined here are those which past experience indicates will most efficiently and completely give the information required.

Preliminary Work:

During the tests all of the circuits on the telephone pole lead will be disconnected from the rest of the telephone system at each end of the exposure in order to obtain definite testing conditions and to avoid the effects of secondary induction from other parallels in the system. As this procedure completely interrupts service over the telephone lead, it will ordinarily be necessary to make the tests at night. Good grounds will be made at the test poles at each end of the exposed section of the telephone line. Two pairs of

wires well insulated and well transposed will be run from the station where the tests are to be made to the telephone pole line.

Condition Tests:

Two telephone lines will ordinarily be connected in for test at the same time, and where possible these two circuits will be side circuits of a phantom so that these tests may be made at once on two physical circuits and one phantom circuit. The tests will be made on a sufficiently large number of telephone circuits to ensure that an idea has been obtained of the extreme and average conditions of the lead. The tests are briefly outlined below:

1. Tests of the capacity and insulation balance of each telephone circuit.

2. Tests of the total noise induced in the telephone circuits.

3. Tests of the current flowing between the telephone wires and ground on short circuit and of the voltage induced between telephone lines and ground on open circuit.

4. Observations of the voltage from each power line to ground and also of the residual voltage, that is, the vector sum of these three voltages. Observations also of the current in each line wire and of the residual current, that is, the vector sum of these three currents.

5. Resonance analyses of the induction between telephone wires and from telephone wires to ground, and of the above named voltages and currents in the power system.

6. Oscillograms of the voltages and currents in the power and telephone systems mentioned in Item 5.

B—Tests on Telegraph Circuits:

Arrangements will be made by which all of the telegraph circuits on the telegraph line may be opened at the same time for short periods during which tests are being made in order to obtain definite testing conditions, and to eliminate the effect of secondary induction. Arrangements will also be made so that the telegraph wires may be looped one at a time into the stations where the tests are being made.

Tests will then be made on each telegraph wire of the voltage to ground with both ends open circuited and with the distance end connected to ground, and of the current flowing through the circuit with both ends connected to ground. A sufficient number of oscillograms should be taken to determine the wave shapes of the induced disturbance under different conditions.

These tests will be carried out on a sufficiently large number of telegraph wires to determine to what extent the disturbance is different for circuits on different pin positions of the telegraph lead.

Simultaneously with the above tests observations will be made of the voltages and currents in the power line as outlined in paragraphs 4, 5 and 6 under "Tests on Telephone Circuits." These observations need, however, include only the magnitudes of the fundamental and of the one or two most prominent harmonics.

C—Tests on Railroad Signaling Circuits:

Observations and oscillograms will be made of the maximum alternating current induced in the railroad signalling circuits under different conditions.

D—Miscellaneous Tests:

It may be found desirable to make further tests on some other types of equipment, such as the telegraphone or of the other types of circuit which are not considered above.

Conditions of the Power Circuits.

The following is a general outline of the different conditions of the power circuits under which tests should be made. In this outline no attempt has been made to go into detail as it is felt that the detailed tests will be modified according to the exigencies of operation and that additional tests will be suggested by the results of the tests here outlined:

1. Tests with the power line cut dead, to determine that under these conditions the signalling circuits are free from disturbances.

2. Tests of the inductive disturbance under normal operating conditions, both light and heavy load.

3. Tests of the effect of different transformer connections on the induction in signalling circuits.

4. Tests of the effect of grounding and opening the neutrals of star connected transformers.

5. Tests of the effect of operation of relief and emergency steam stations.

6. Tests of the effect of charging aluminum lightning arresters.

7. Tests of the effect of switching high tension lines.

8. Tests of the disturbance caused by known residual voltages and currents. In these tests the conductors of the power line involved in a given parallel will be cut dead and a known voltage will be impressed between the three power wires in parallel and the ground. Tests of the effect of unbalanced current will be made by passing a known current through each of the line wires with a ground return.

9. Tests with one line wire grounded. In these tests the method of procedure will probably be to create a ground on one wire when the line is dead and then to switch potential on the circuit.

The sub-committee on Program is analyzing information now being sent in by the communication and railroad companies concerning parallels with which they are now experiencing difficulty and information which the power companies are sending in regarding their systems. With this information it will report recommendations for future tests.

It is hoped that within a year or two valuable results will be obtained which may serve as the basis of recommendations to the Railroad Commission.

It is the intention of the joint committee through the sub-committee on publicity to furnish to the technical press from time to time such information as may indicate to the engineering public and to the corporations concerned the nature of the work being undertaken and the results obtained up to the date of publication of the report in so far as these results can be considered to be final.

The object of making such application is for the information of the interested companies and of the engineers of the country, with the expectation that they will show an interest in the work now being done in California by such constructive criticisms and suggestions as will further the work of the joint committee on inductive interference and that in the end all sections of the country may profit by the results of their labors.

JOURNAL OF ELECTRICITY
POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Pump and the Reservoir

A short seasonal rainfall makes the farmer's fancy turn toward possible means of artificial irrigation. Likewise the energetic power salesman is not indifferent to the psychological effects ensuing, namely, an opportunity to spike a new consumer for his company.

The present month is undoubtedly witnessing the most heated campaign ever experienced in the West in the installation of electrically operated pumps. Thousands of new pumping loads are soon to exert their influence upon the central station meters. The rates as a whole which have been instituted in the rural communities by the central stations are satisfactory. They will enable the farmer to send a better product upon the market and in larger quantities per acre, thus ensuring him a greater net return per acre through the utilization of electric power.

There are, however, many additional points that might well be borne in mind both by the farmer consuming the electrical energy and by the central station furnishing the supply. In many instances the farmer has been urged by the over-zealous power salesman to install a pumping outfit of such proportions that he will scarcely utilize his minimum guaranteed consumption during the irrigation season and thus be unable to take advantage of the attractive sliding scale of rates offered by the central station. Such a procedure as this, while temporarily inflating the boasted connected load of the central station, aids little in a broad policy of educating the farmer in the economic use of electrical energy. Only by means of the power salesman's being able to win the confidence of his justly suspicious consumer can the ultimate universal triumph of electrical energy-consuming devices upon the farm be attained.

Thus, the power salesman who sees upon a farm, from its natural topographic configuration, the possibilities of economically storing water and fails to impress this economic law upon his client will some day awaken to the fact that co-operation on the farm is an impossibility. In those communities where the agriculturist has been encouraged to store water and thus enable him to operate his plant upon a hundred per cent power factor while at his convenience he is enabled to irrigate with a proper head of water from the reservoir, electrical consumption is by far the more advanced.

Such practice has the advantage, too, not only of making it possible to irrigate other lands thought to be beyond the economic range of the electrically-operated pump, but it materially aids in maintaining a better load-factor throughout the hydroelectric network. The rapid growth of the electrical industry has indelibly exposed one glaring fallacy to the engineering world, namely that a decreased consumption of electrical energy per unit of accomplishment decreases the sales output accordingly. Such a fallacy

was long feared, but the advent of the tungsten lamp wherein candlepower per kilowatt of electrical energy is vastly heightened, has unmistakably resulted in increasing the electrical consumption in every American home by opening new and broader fields of electrical application.

And so it must be upon the farm. In every case wherein the farmer is enabled to utilize electrical energy according to the most economic law, the central station will reap a correspondingly enlarged field of electrical consumption. The small farm reservoir, then, enabling the farmer to take advantage of the cheapest rates, should be encouraged by the central station, whenever such practice is reasonably feasible.

Apprenticeship Systems for Utility Service

The increasing popularity for agricultural professional training throughout the West and for mechanical and electrical engineering endeavor along these lines are already having their effect in limiting the number of young men who desire to prepare themselves for a central station engineering career. The public utility fraternity may well seriously consider the inauguration of some apprentice system of training which will prove an attractive and profitable experience for those who some day are to be the nucleus for operation, maintenance and engineering skill of the public utility regime.

The personnel of a works is of a scarcely less importance to its success than the quality of the plant and machinery. Indeed, Western experience would strongly indicate that more has been accomplished by a loyal, enthusiastic well-trained corps of workers than by any other factor. Witness for example the industries and utilities of the West, in some instances, swept from the face of the earth by fire and yet today these self-same industries and utilities, buoyed up by the tireless effort and loyalty of its personnel, have overcome every obstacle. The work being accomplished by the great hydroelectric corporations of the Northwest and Southern California, too, amply demonstrate the efficiency of men and not matter. Hence the problem of educating and preparing suitable men to carry on this work is one of much importance. Though Western conditions are vitally different from those in the East, or in Great Britain, still some ideas may be gleaned from the practice of our older brothers. Thus, Eastern apprenticeships are naturally segregated into three main classes. The first class consists of boys of not less than 15 years of age who desire to become artisans or "tradesmen" on reaching the age of twenty-one. They must produce proofs of having had a satisfactory elementary education and must attend evening schools of technology during their years of apprenticeship. Young men not under 17 years of age of good general education and of recognized technical training may constitute a second class. This class is for youths who desire practical training in different branches of engineering. Throughout their apprenticeship they are transferred from department to department so as to obtain as wide an experience as possible. Such men must continue their technical education at an approved technical school, or at the university, special permission being granted for necessary absence from duty. The third class constitute young men not less than 20 years of age who desire to acquire a practical workshop training. They must have passed through a complete course of technical training, or obtained an engineering or science degree at the university. Great importance is attached to the educational qualifications that the candidate is able to submit. A written agreement is entered into for a definite period, and although the firm does not guarantee that men in this class shall spend a specific time in any particular department, the management as far as is possible, however, selects such departments as is most suitable to the attainments and capabilities of each man.

It would seem that, since the day of first things has now passed in Western utility development, the time is ripe for earnest consideration of the utility apprenticeship. Hitherto fate or chance happening has largely determined the preparation of men supposed to be technically qualified for Western utility work. The new order of things, built upon a more substantial and permanent basis requires men of highly specialized training. Particularly should the future executives, division managers and operating engineers be thoroughly trained for their duties. The great metropolitan districts of the West are now well equipped with technical schools. Men for class number one might well be prepared by educational and welfare work among the rank and file similar to that instituted by the New York Edison Company. It is surprising to what heights efficiency may thus be engendered.

Fortunate is the utility company that develops throughout its mass of employes, a whole-hearted love and loyalty to the utility regime. Many Western companies today possess this god-given attribute pervading the working classes. Deep consideration should be had by the present executives of these utility companies in evolving methods to perpetuate such a race of men, for, as said Goldsmith in the Deserted Village,

> "Kings may come and kings may go,
> But a bold peasantry once destroyed can never be replaced."

Preparation of future lieutenants and captains of utility service on the other hand, should be undertaken as outlined in classes two and three. How vastly more practical and of what real service would our Western technical schools thus become if their theoretical technical training were made to synchronize somewhat so as to aid in apprenticeship courses as given in the latter two classes. Neither the utility company nor the apprentice need be under obligation one to the other. A plain survival of the fittest should pick the future leaders. Thus will utility service be immeasurably heightened and technical training be most effectual.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, is at Seattle.

K. G. Dunn, of Hunt, Mirk & Company, is expected to return from a six weeks' Eastern trip about April 1st.

Harry Kirkland, of the American Conduit Manufacturing Company, left the first part of the week for Portland.

H. B. Squires, manufacturer's agent at San Francisco, is making a brief trip throughout the Pacific Northwest.

Frank Quinn, of the Manhattan Electrical Supply Company, is making a two weeks' trip through the Pacific Northwest.

J. A. Herr, sales engineer with Sprague Electric Company, is visiting the towns of the San Joaquin Valley, California.

J. C. Bird, local manager of the Kendrick Electric Company, Tacoma, spent two days in Portland recently on personal business.

F. N. Boyer, assistant manager of the Chicago office of the General Electric Company, and Mrs. Boyer, are on a trip through California.

John S. Stone, a consulting electrical engineer of Boston, is at San Francisco in the interest of several prospective exhibitors at the Panama-Pacific Exposition.

E. M. Cutting has been appointed manager of the California District of the Edison Storage Battery Supply Company, with headquarters at 818 Mission street, San Francisco.

Miles Steel, sales engineer with the Benjamin Electric Company, returned to San Francisco this week from Southern California and left later in the week for Portland and Seattle.

W. S. Hanbridge, secretary of the California Electrical Contractors' Association, has just completed a trip throughout the various California towns in the interests of his association.

Frederick Pratt, president of the Stone & Webster Corporation, Boston, visited in the northwest for some time recently, looking over various properties in Seattle, Tacoma and Bellingham.

H. E. Sherman recently resigned his position with the Oakland, Cal., office of the Great Western Power Company to rejoin the San Francisco sales force of the Crocker-Wheeler Company.

Frederick G. Simpson, chief engineer and general manager of the Kilbourne & Clark Manufacturing Company, Seattle, has gone east with a view to purchasing machinery for the plant being erected.

W. W. S. Butler, vice-president and general manager of the Western States Gas & Electric Company, at Stockton, was at San Francisco during a hearing of the California Railroad Commission this week.

C. E. McFarland, formerly vice-president and general manager Nebraska Telephone Company, has succeeded **C. C. Bradley**, who recently resigned a similar position with the Pacific Telephone & Telegraph Company.

Garnett Young, manager of the Telephone-Electric Equipment Company, announces the opening of a sales office at Portland in charge of **Fred H. Smith**, formerly with the Seattle branch, of which **F. G. Larkin** continues as manager.

Llewellyn Evans and **E. H. Little** of the Evans-Dickson Company, Tacoma, spent several days recently in Port Townsend in connection with work on the lighting system and pole line which the company is installing at Fort Casey, Washington.

R. E. Gorton, general manager of the Packard Lamp Company at Warner, Ohio, is at San Francisco with Mrs. Gorton. He is making his headquarters with the Electric Appliance Company, who are the Pacific Coast distributors for Packard lamps.

MEETING NOTICES.

San Francisco Section A. I. E. E.

Following is the schedule of meetings for the San Francisco Section of the American Institute of Electrical Engineers:

February 28—"Operation of Transmission Systems," by Lee Hagood.

March 28—"Description of An Inventory and Valuation of a Gas and Electric Plant," by H. W. Crozier.

April 25—"Electrically Operated Drawbridges," by G. W. Welch.

May 23—"Multiplex Telegraph and Telephone Circuits," by W. R. Birt.

June 27—"Economies of Production and Use of Electric Power," by C. L. Cory.

The meetings of the Section are held Friday at 8 p. m. in Native Sons' Hall, 430 Mason street. All electrical men are invited to attend.

Spokane Section, A. I. E. E.

A preliminary meeting to arrange for the formation of the Spokane Section of the A. I. E. E. was held on March 3d. Mr. John B. Fisken was elected temporary chairman, and H. B. Peirce, secretary. A committee on by-laws was appointed to report at the next meeting when permanent officers will be elected. At that time Mr. D. F. Henderson will give an address on the benefits to be derived from a local section.

Portland Section, A. I. E. E.

The next regular meeting of the Portland Section of the A. I. E. E. will be held at 8:15 p.m. in the club rooms of the Oregon Technical Club, 247½ Stark street, March 18th. A paper will be presented by Mr. O. C. Brill, district plant engineer for the Pacific Telephone & Telegraph Company in Portland, Oregon, on "Long Distance Telephone Transmission on the Pacific Coast."

Portland Section, A. S. C. E.

The Portland Chapter of the American Society of Civil Engineers held an informal dinner at the Portland Commercial Club, Thursday evening, March 13, 1913. Major J. J. Morrow, Corps of Engineers, U. S. A., talked on "Railroad Development of Alaska." Major Morrow is chairman of the board appointed by the president of the United States to investigate railroad conditions in Alaska and his preliminary report to the local chapter was of intense interest.

Portland Jovian Lunch Club.

The regular Thursday lunch club of the Portland Jovian Lunch Club, met at noon in their new quarters in a private dining room adjoining the grill of the new Oregon Hotel Annex, about 50 members attending. Mr. C. P. Osborne presided as vice-chairman and Mr. C. F. Swigert gave a "talk" on his experiences in connection with the early generation of electric power in Portland twenty-three years ago.

Tacoma Jovian Luncheon Club.

The Tacoma Jovian Luncheon Club was recently reorganized and is holding its luncheons every second and fourth Tuesdays at the Olympus Cafe. The luncheons are handled by an entertainment committee and it is the intention to have a speaker or speakers appear at each luncheon for the discussion of subjects in which all are interested. Officers of the club are: K. C. Schluss, Statesman and Chairman; E. H. Little, Secretary, and P. L. Hoadley, Treasurer.

Seattle Jovian League.

The regular weekly luncheon of the Seattle Jovian League was held at the Rathskeller Friday noon, March 7. About 40 Jovians attended. C. F. Terrell of the Puget Sound Traction, Light & Power Company, gave a talk and demon-

strated the working of the pulmoter in its application to resuscitation from electric shock. Much interest was manifested and a good program was carried through. The Jovian League of Seattle has decided that instead of holding its usual spring rejuvenation it will wait until the holding of the Northwest Light & Power Convention in the fall. One evening during that week will be turned over to the Sons of Jove. The applicants will be gathered and under the circumstances the best of results are expected. C. M. Bliven is Chairman of the League, Burton R. Stare, Statesman, and R. G. Barton, Secretary. Interest in the work has greatly increased during the past four months and the attendance at the weekly luncheons has steadily grown.

Oregon Technical Club.

The regular Tuesday luncheon, on March 4th in dining room "B" of the Portland Commercial Club, was attended by 62 members and their guests. W. G. Holford was chairman and Mr. F. H. Whitfield was the speaker of the day. His subject "Dreams for Dreamers" was very original and chosen by him to convey the speakers' idea of what should be the ideals of the Oregon Technical Club. The argument he presented to his audience was the argument that engineers must use their imagination before they commence to work out any material project; that is, they must figuratively "dream" first—then create their "dreams" into realities; therefore, he warned the Oregon Technical Club to be sure their "dreams" were never small and selfish, because they would surely react and no good could possibly come from some. Also, be careful not to choose "disastrous dreams" and wreck our organization, which as now organized was sure to produce many of its "dreams" into "Practical Realities," which would work a lasting benefit for the Commonwealth of Oregon.

ELECTRICAL DEVELOPMENT AND JOVIAN LEAGUE.

The regular monthly business meeting of the League was held last Tuesday. After completion of the routine business the report of the Golden Poppy Special No. 2 Committee, which showed much progress and an active interest in same on the part of the electrical men of the West, was approved. Over fifty have already signified their intention of attending the N. E. L. A. convention and joining the special train party leaving San Francisco the last week of May.

The speaker of the day was A. H. Griswold, plant manager of the telephone company, who told of "Some of the Fundamental Principles in Telephone Plant Construction."

REJUVENATION TO BE HELD AT SACRAMENTO.

Arrangements are being rapidly perfected for a Rejuvenation of the Jovian Order at Sacramento, California on the evening of March 29th. On March 8th a number of live wires met at lunch at the Hotel Sacramento and after listening to talks by Arthur E. Rowe, special plenipotentiary, A. E. Dundell, Jupiter of the San Francisco degree team, and Arthur H. Halloran, Statesman for Northern California, selected a membership committee consisting of C. V. Schneider, chairman, and C. R. Gill, secretary-treasurer. Arthur F. Peck has charge of the arrangements for a meeting place. Others active in the work at Sacramento are G. B. Baldwin, G. S. Pierce. R. C. Eyerly, H. R. Wilbur, C. H. Middlemas, J. C. Love, J. A. Woods and Douglas Jones. It is believed that a class of fifty will be admitted to the order at this time.

The degree team and Jovians from the San Francisco bay cities will go to Sacramento by boat on Friday night, March 28th, arriving Saturday morning. The day will be spent in Sacramento, the rejuvenation will take place at night and the return will be made on Sunday. Many of the members will take their families and every provision will be made for the entertainment and comfort of the ladies.

LECTURES ON GAS ENGINEERING.

The following lectures are to be delivered at the University of California by E. C. Jones, the well known gas expert. The public is invited to attend any or all of this interesting series:

February 17, 1913—The Manufacture of Coal Gas.
March 3, 1913—Purification of Coal Gas.
March 17, 1913—The Manufacture of Water Gas.
March 24, 1913—(Visit of the class to Potrero Gas Works).
March 31, 1913—The Manufacture of Oil Gas.
April 14, 1913—Distribution of Gas.
April 28, 1913—Measurement of Gas.

TRADE NOTES.

The Home Electric Company, Tacoma, has discontinued its retail store and is doing a strictly jobbing business.

The Pacific Light & Power Corporation of Los Angeles placed a large order for underground cable with the Safety Insulated Wire & Cable Company, this week.

The Grays Harbor Lumber Company at Hoquiam, Washington, will install a 500 kw. turbine with switch, 10 kw. generator and 7 kw. turbine exciter. The General Electric Company supplied these facilities.

A. L. Meyers & Company have recently moved to larger quarters at 111 New Montgomery street, San Francisco, where they are prepared to furnish Connecticut telephones, Bonnell adapter boxes, Canfield tape, Lux tungsten lamps and Knowles loom.

Mr. Hemple of the Alaska Light & Telephone Company, Valdez, was in Seattle recently, where he closed a contract with the General Electric Company for a 250 kw. generator for direct connection to a Pelton water wheel with switchboard, etc.

The General Electric Company gives notice of the sale to the Oro Electric Corporation, San Francisco, Cal., at Stockton, Cal., of a 1000 kw. Curtis turbo-generator with 10 kw. turbo-exciter and 14 kw. generator, Tirrill regulator, 20 h.p. motor and switchboard.

"Electron" is the interesting name chosen by the new publication of the Central Electric Company of Chicago, Ill. It is the aim of the new house organ to symbolically represent electrical power as the electron does in the present theory of constitution of matter. The first number, just distributed, is snappy and instructive.

A. L. Thorn, superintendent of the city electric works, Tacoma, states that the Nisqually power plant, put in operation more than four months ago by the city, has run to the present time without a shut down for repairs. It has also been discovered that the wheels at the works do not require half the water anticipated.

The Pacific Light & Power Corporation, Los Angeles, Cal., has ordered ten 5000 k.v.a. and three 1000 k.v.a. transformers, and the Great Western Power Company, San Francisco, Cal., will install in its station at Denverton, Cal., six 300 k.v.a. transformers and two panels; also three 300 kw. transformers in the station at Sheldon. The Ventura County Power Company at Oxnard, Cal., has ordered a 500 kw., 3000 r.p.m., 50 cycle, 2300 volt, turbo-generator set. All the foregoing will be supplied by the General Electric Company.

The Electric Safety Appliance Company, Tacoma, of which A. Z. Smith of the A. Z. Smith Electric Company is the prime mover, is getting ready to begin the manufacture of a safety appliance to be used in operating elevators and which is intended to work in such a manner that the elevator cannot be used when the doors are open. The patents cover the United States, Canada, England, France and Belgium. One of these appliances is to be installed in the new Central school building, Tacoma.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

STANDARD SPECIFICATIONS FOR WIRING BUILDINGS.

(Continued.)

Example No. 4. For conduit work in a store, office or hotel building in the overhead district having only individual meters for the various tenants and no master meter.

Service.

(72) From a point fifteen (15) feet above the ground on the Portland Railway, Light and Power Company's pole on .... Street, approximately .... feet ....of ....Street, the wiring contractor is to run a set of 3-conductor service mains for the whole lighting system, in metal conduit, down the pole, under the sidewalk and through the basement floor to the main service switch and cutout located at point shown on basement plan. The top of the conduit on the pole is to be equipped with a Type "F" condulet.

(73) A set of service mains for the whole power system is to be run between the above-mentioned points in the same manner.

(74) At the point shown on basement plan, the wiring contractor is to furnish and install a service switch and enclosed fuse cutout for the entire lighting system, same to be enclosed in a sheet steel cabinet made up of not less than No. 12 sheet steel with a door of not less than No. 10 sheet steel, same to be fitted with a suitable spring latch and hinged at the top so as to be self-closing.

(75) At the same point, a service switch and cutout for the entire power system is to be furnished and installed in the same manner.

(76) From their respective main service switches the wiring contractor is to extend the service mains for the light and power systems to the meter board located at point shown on plans.

Meter Board.

(77) At the point shown on plans, the wiring contractor is to furnish and install a meter board of sufficient size to accommodate the necessary number of meters for the entire building, with at least 6 inches spacing between and around each meter. The board is to be made up of 1¼-inch thoroughly seasoned fir S. I. S. and of such dimensions and placed at such height that the highest meter will not be more than 7 feet from the floor nor the lowest meter less than 3 feet from the floor. On this board the wiring contractor is to furnish and install the necessary branch cutouts and wiring for the meters. The branch cutouts for the individual light and power meters are to be arranged along the lowest part of the board and enclosed in a covered trough or cabinet, and all wiring between same is to be on face of board. (See Portland Railway, Light and Power Company's blueprint D. F. 12, showing the above arrangement.)

Meters.

(78) Standard General Electric Company's recording wattmeters arranged for side connection will be furnished and installed by the Portland Railway, Light and Power Company, but all necessary wiring to and from same is to be furnished and installed by the wiring contractor.

Lighting Feeders.

Copy clause (65).

Power Feeders.

Copy clause (66) and last clause of Example 1.

Cutout Cabinets, Branch Circuits, Switches.

Same as Example 1.

Example No. 5—For Concealed Knob and Tube Work in a store, office or hotel building in the Overhead District having only individual meters for the various tenants and no master meter.

Service: Copy clauses (72) to (76) inclusive.

Meter Board: Copy clause (77).

Meters: Copy clause (78).

Lighting Feeders: Copy clause (65).

Power Feeders: Copy clauses (68) and (69).

Cutout Cabinets:

Copy clauses (70) and 71). Copy clauses (46) and (47).

Branch Circuits: Copy clauses (48) to (53) inclusive.

Switches: Copy clauses (54) to (60) inclusive.

Example No. 6—For Concealed Knob and Tube Work in an apartment building in the Overhead District, having individual meters for the various tenants and underground service down pole.

Service: Copy clauses (72) to (76) inclusive.

Meter Board: Copy clause (77).

Meters: Copy clause (78).

Lighting Feeders:

(79) From their respective meters on the meter board, feeders are to be run as follows:

(a) One 3-wire to the branch cutout cabinet in the janitor's quarters, same to be known as the house feeder.

(b) One 3-wire to the branch cutout cabinet in each of the apartments having more than 12-16 c.p. lamps or their equivalent. (80) For those apartments having 12-16 c.p. lamps or less, a 2-wire feeder is to be run direct to the lamp and switch outlets in those apartments.

Power Feeders:

(81) From the power meter on the meter board, a feeder is to be run to the elevator and terminated in a wooden switch cabinet, same to be thoroughly lined with asbestos and painted to comply with all rules and requirements. The door is to be fitted with a suitable spring latch and hinged at the top so as to be self-closing. In this cabinet is to be mounted a proper switch and cutout and provision made for future connection to motor leads.

Cutout Cabinets:

(82) In the janitor's apartment and in each of those apartments having more than 12-16 c.p. lamps or their equivalent, wooden cutout cabinets are to be furnished and installed, same to be lined with asbestos and painted to comply with all rules and requirements. The doors of same are to be fitted with suitable spring latches and hinged at the top so as to be self-closing. The wiring contractor is to furnish and install the cabinets complete. The cabinets are to contain the necessary three-to-two wire plug cutout branch blocks.

Copy clause (71).

Branch Circuits:

Copy clauses (48) and (49).

(83) From the branch cutout cabinet in the janitor's quarters the necessary branch circuits are to be run to the outlets for the lamps in the main entrance and in the common halls and stairways and in the common basement.

Switches:

(84) All ceiling outlets connected by curved lines to switch outlets, which are indicated thus ("S") on plans, are to be controlled by flush push button switches with face plates to match other hardware. There are to be separate snap switches located in the janitor's apartments to control the hall and stairway lamps on each floor.

(85) The lamps near the foot of the stairs in the basement are to be controlled by a rotary snap switch placed just inside of the door leading to the basement from the main entrance. The lamp in the main entrance is to be controlled by a rotary snap switch located in the janitor's apartments.

(86) All the ceiling outlets in the rooms are to be controlled by flush push button snap switches, located as shown on plans, with face plates to match other hardware.

(To be continued.)

INDUSTRIAL

WESTINGHOUSE OZONIZER.

The use of ozone as a purifying agent has now become a well established custom; the particular fields of application being in offices, clubs, school rooms, churches, theatres, dwellings and similar places.

Ozone is also found to be a preservative agent against mould and putrefaction in foods, and in pulmonary diseases gives relief and often effects a cure.

One Westinghouse ozonizer will generally produce sufficient ozone to purify the air in a room having an area of 40 square feet and the average height.

The ozone oxidizes the various animal and vegetable substances which it attacks and renders them odorless. In addition it also attacks bacteria and germs in the air, rendering the air sterile and healthful, a fact that makes the ozonizer particularly useful in hospitals, dispensaries and operating rooms.

The Westinghouse ozonizer consists of a step-up transformer, tubes for generating the ozone and a regulating switch, all contained in an easily portable case. The function of the transformer is to raise the voltage of the supply circuit to that required by the ozone generating tubes.

These tubes are of glass of special construction, having an outer coating of metal made to adhere closely to the glass by a special process. The inner walls of the tubes are lined with a metal mesh which forms the ozone generating surface.

Westinghouse Ozonizer.

The outer coating is connected to one terminal of the high tension winding of the transformer, and the inner coating is connected to the other high tension terminal. The uneven distribution of potential by the metal mesh on the inside of the tubes produces a large number of tiny brush discharges which generate ozone.

The generating cylinders are located above the transformer and stand vertically, so that the warm air rising from the transformer and from the inside of the generating tubes causes an upward draft, drawing in fresh air at the bottom and giving off a uniform flow of ozonized air at the top.

On top of the case is a knurled knob connected to the regulating switch located inside the case, which is connected to the generating tubes in such a manner that, by turning the knob to the positions indicated on the dial, the number of tubes in operation may be regulated from one to four, with a corresponding change in the unit of ozone.

The cylindrical part of the case is of heavy sheet metal and the top and bottom of wood. This wood is thoroughly seasoned, and heavy enough to prevent warping.

The ozonizer is furnished with either one of two kinds of finish; one being white enamel all over, which is intended for hospitals and dispensaries. The other finish is polished mahogany for the wooden top and bottom and dull black for the remainder of the case; this finish being recommended for offices, churches, and places having polished woodwork.

Although the voltage is stepped to a high value, the circuits are so thoroughly insulated, and all exposed metal parts are electrically connected together, so that no difference of potential can exist between them even though a part of the circuit should become grounded on the case.

The ozonizer is made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

BENJAMIN SOCKET EXTENSION FOR 60 WATT UNSKIRTED BASE MAZDA LAMPS.

The lamp manufacturers are now furnishing the 60 watt Mazda lamp with unskirted medium screw base. The distance from the base contact to the center of the filament has thus been shortened approximately an inch and the proper relation between filament and reflector accordingly destroyed.

Benjamin Socket Extension for 60 Watt Unskirted Base Mazda Lamps.

The Benjamin socket extension No. 91 meets this condition by lengthening the sockets just enough to overcome the defect involved. The new lamp can thus be used without a change of reflector with proper lighting results. Other changes that can be made are from 60 watt skirted base Mazda to 40 watt Mazda; 40 watt Mazda to 10, 15, 20 watt Mazda; 100 watt Gem to 25 watt Mazda; 50 watt Gem to 10, 15, 20 watt Mazda.

NEW DEPARTURE IN SAWMILL DRIVE.

The Eagle Lumber Company at Timber, Oregon, are now building a new sawmill, in which a 22 in. x 20 in. heavy duty side crank Skinner automatic engine, is direct connected to the main line shaft. The engine speed is 210 r.p.m., steam pressure 125 lb., rating 600 to 800 h.p. This same engine in addition to driving line shaft is belted to head hand mill. Another 18 in. x 20 in. Skinner engine is belted to a smaller part of mill. The entire equipment of the mill, in addition to the above, was furnished by the Allis-Chalmers Company. The output of this mill will be 125,000 to 150,000 feet per day of 10 hours.

The Wheeler Lumber Company, of Wheeler, Oregon, are installing an installation, which is a duplicate of the Eagle Lumber Company's Mill, and the equipment is all furnished by the Allis-Chalmers Company.

NEWS NOTES

INCORPORATIONS.

OLALLA, WASH.—Olalla Telephone Company, $10,000, by H. F. Hall, John Karcher and others.

SACRAMENTO, CAL.—National Wireless Telephone & Telegraph Company of Arizona, $2,000,000, by L. Cassidy and others.

LOS ANGELES, CAL.—Gem Lake Power & Water Company; capital stock, $1,000,000; by J. H. McCarthy, W. A. Ramsay, H. V. Henry, J. T. Bunn and F. E. Edwards, directors.

SANTA BARBARA, CAL.—Articles of incorporation for the Domestic Water Company of Santa Maria have been filed. The company is capitalized for $250,000. The incorporators are C. H. Beus, T. A. Allan, A. H. Eddy, all of San Francisco.

SANTA ANA, CAL.—Articles of incorporation of the Dawn Water Company have been filed, with capitalization of $10,000. The incorporators are J. A. Nunn, R. J. Thompson and Harry Lewis. The new concern proposes to develop, acquire, distribute and sell water for irrigation purposes.

ILLUMINATION.

CONCONNULLY, WASH.—The electric plant owned by Morton & McDaniel was recently destroyed by fire.

ALHAMBRA, CAL.—The city council has awarded a contract for ornamental lighting posts for Garfieid, Main and Fair Oaks avenue, to the Newberry-Bendheim Electric Company, for $20,456.

RIVERSIDE, CAL.—The Southern California Edison Company has been granted a franchise to construct and maintain for 50 years, poles, masts, and other superstructure, upon which to suspend wires, cables and other appliances for transmitting electricity.

OWENSMOUTH, CAL.—The Southern California Edison Company will begin the erection of a substation at the corner of Market street and Sherman way at once, for the purpose of furnishing light and power to Owensmouth. F. O. Engstrum Company of Los Angeles, have the contract for the building.

SEATTLE, WASH.—The Seattle Lighting Company, S. R. Hutchinson, superintendent, has filed a new rate on gas with the public service commission, same to take effect on and after April 1st. The rate provides for the first 5000 cubic feet at $1000 per thousand, the next 35,000 cubic feet at 80 cents per thousand, the next 60,000 at 70 cents per thousand and all over 100,000 cubic feet at 60 cents per thousand.

GRANTS PASS, ORE.—By a decision handed down by Judge Bean in the United States District Court, the city council of Grants Pass received notification that it was not permitted to interfere with the rulings of the State Railroad Commission, when it had fixed rates under the utility act. The California & Oregon Power Company had been supplying that city with power and illumination at a rate that the council determined was too high. An ordinance reducing the rates was passed, notwithstanding the commission's schedule. In his decision Judge Bean held the state board has unquestioned authority in the matter, and that its rates should be operative until the city of Grants Pass could have them changed by that body.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has been awarded by the Panama-Pacific International Exposition Company contracts for supplying electricity for light and power, gas for illumination and steam for heating purposes. The work of installation will be commenced at once, the contracts calling for the service to extend through the period of construction and during the season of the exposition. The electric contract specifies a minimum installed capacity of 12,000 h.p. during the constructive period of the exposition and 20,000 h.p. after the gates have been opened. The Pacific Company will construct a generating station on the exposition grounds. This will be an auxiliary to the company's big plant in the Potrero and will also be the company's exhibit at the exposition, the building being open to visitors during the regular visiting hours. The steam contract calls for 30,000 pounds of steam per hour from 10 a. m. until 5 p. m. Gas will be supplied from the plant at the foot of Hyde street. It is estimated that the gross revenues will amount to $500,000.

TRANSMISSION.

PLUMAS, CAL.—The Indian Valley Electric Light & Power Company is making arrangements to enlarge its plant to 30,000 h.p.

BEND, ORE.—The Bend Water, Light & Power Company has commenced the installation of a power line to the planing mill south of Bend. Cedar poles will be used.

BURNABY, B. C.—Superintendent Wm. McNeill of the Western Canada Power Company, states that the power line across Burnaby to N. Arm Frasier River and Lulu island is contemplated.

OCEANSIDE, CAL.—F. F. Foster & Company, of Los Angeles have been awarded the contract to build a power line from Oceanside to San Luis Rey for the Oceanside Electric Company. The line is to furnish power for pumping for irrigation, also for lighting purposes.

TUCSON, ARIZ.—The Borderland Mines Company has completed financing of a power plant to be located at Calabasas. The line will run to Oro Blanch through the Santa Cruz valley, furnishing cheap power to mines in that section. Tood C. Woodworth is president of the company.

WENATCHEE, WASH.—William F. Scheffel, believed to represent the Edison Electric Company, has filed on 25,000 inches of water per second of the Columbia River water at Rock Island, to be used in development of electric power for irrigation, lighting, heating, pumping and mechanical purposes.

MARYSVILLE, CAL.—Application has been made to the board of supervisors, by the Great Western Power Company, for a franchise to erect lines, etc., for transmitting electricity along certain streets and highways in the county of Yuba. Sealed bids will be received up to 11 a. m. April 9th, for the sale.

VISALIA, CAL.—Application has been made by Albert C. Agnew to the board of supervisors of Tulare county, for a certain franchise granting the right to construct and for a period of 50 years operate an electric tower and wire system across certain public highways, in said county. Similar applications have been made in Glenn, Colusa, Butte and Shasta counties.

CHICO, CAL.—The city trustees turned down the application of the Sierra Electric Power Company for a franchise to serve the people of this city with electricity. The local field is now covered by the Pacific Gas & Electric Company and the Northern California Power Company. The Sierra company is getting a county franchise, and also permits in many cities of the valley, its plant is to be located at Manton, Tehama county.

LOS ANGELES, CAL.—Official call for an election to vote bonds in the sum of $17,600,000 has been issued, setting the date for the election April 15th. All of the propositions submitted with the exception of the issue of $1,000,000 for water main extension were placed on the ballot. The projects and amounts called for on the ballot are: Aqueduct power-distributing system, $6,500,000; Chatsworth line of aqueduct, $2,000,000; Franklyn canyon line, $1,500,000; San Dimas high line, $2,500,000; harbor improvements, $2,500,000; new city hall, $1,000,000; normal school site, $600,000, and municipal railroad, $1,000,000.

TRANSPORTATION.

REDDING, CAL.—Albert C. Agnew has applied to the supervisors for a franchise on the highways of Shasta county for an electric railroad and to build a power line. Agnew has made a similar application to the city trustees of Redding. The board has ordered the sale of the franchise advertised. Oakland capitalists are supposed to be interested in the proposed electric railroad.

SAN FRANCISCO, CAL.—The Ocean Shore Railroad Co. has applied to the Railroad Commission for authority to issue $700,000 of 6 per cent bonds, maturing in 1916. It is stated in the application that the capital to be thus secured is to be used for the purchase of land for right of way purposes upon which the Ocean Shore at present has only a leasehold, and for the purchase of the property for right of way purposes; for the purchase of equipment; for compliance with possible franchise requirements in the city of San Francisco, and for making preliminary changes. The application states that the cost of these improvements will be $250,000. The company asks authority to pledge the $700,000 of bonds as collateral security for a loan of $250,000, to be negotiated with the Union Trust Company of San Francisco.

TELEPHONE AND TELEGRAPH.

ALTURAS, CAL.—Application has been made to the board of supervisors for a telephone and telegraph franchise in the county of Modoc. Sealed bids will be received up to April 8th, for the sale of said franchise.

VISALIA, CAL.—An application has been made to the board of supervisors for a franchise for a period of 50 years to erect and operate a telephone line in certain highways of Tulare county. Sealed bids will be received up to April 8th, for th sale of said franchise.

VANCOUVER, B. C.—The British Columbia Telephone Company has awarded a contract to Coughlan & Sons for the supply of steel work for the big central exchange to be built on Seymour street, between Georgia and Robson streets. A contract was also awarded to Brooks & Weidopp for excavating work in connection with the new plant building of the company to be built on Front street.

WATERWORKS.

FULLERTON, CAL.—Sealed bids will be received up to March 17th for all labor and material required to construct service connections for the distributing system of the Fullerton Municipal Waterworks.

SUISUN, CAL.—At a meeting of the board of trustees a bid was received from G. G. Blymyer & Company, of San Francisco for the purchase of $20,000 water bonds issue of Suisun and the same was accepted by the board.

DAYTON, ORE.—The recent election carried in favor of issuing bonds in the sum of $12,000 for improvement to the local water system. The entire system will be overhauled and renewed with new pipes for the entire city.

SOUTH VANCOUVER, B. C.—Estimates aggregating $182,000 for waterworks purposes next year have been submitted to the council by Water Superintendent Joseph Mullett. The estimates include $14,736 for pumping station; and $83,836 and $66,278 for construction purposes.

GOLDENDALE, WASH.—The city council has adopted an ordinance providing for repairs and additions to the water system and calling an election to vote bonds for the work. New concrete reservoirs, new wood stave pipe are included in the work, which is to cost in the neighborhood of $25,000, for which amount bonds will be voted.

SONOMA, CAL.—The Sonoma Valley Water, Light & Power Company has let a contract to Contractor Volquardsen to sink a series of artesian wells on the Gilbert place. It is the intention of the water company to erect a pumping station on the property and install a pump capable of forcing 300,000 gallons of water through the pipe per minute.

LINTON, ORE.—Bonds have been voted in the sum of $100,000 for the purpose of installing a water system. An engineer will be employed at once to make the survey and prepare plans and specifications. The bonds will run thirty years; interest 3½ per cent. They have already been contracted to Morris Bros. of Portland. The plant is to be connected with the city of Portland mains and a contract will be let within sixty days.

OAKLAND, CAL.—The petition of the people of Oakland to the supervisors of Alameda county to have called a water-district election has been filed with the county clerk. The petition of other municipalities to be included in the district had been filed previously, so that the initial step toward the municipal ownership of water supply for the east bay community has been completed. The county clerk will have ten days in which to verify the signatures and the petitions will then be filed with the supervisors. On March 17, providing the county clerk finds the petitions correct, the supervisors will announce the calling of an election at which the people of the proposed metropolitan water district will be asked to vote for or against the establishment of such a district. The municipalities included and their several mayors who have been working for the creation of the district are as follows: Oakland, Berkeley, Alameda, Albany, Piedmont, Emeryville and San Leandro. The district extends from the Contra Costa county line of Albany to Alvarado, excluding the town of Haywards.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

March 3.

A complaint was filed by citizens of Jamestown, asking that the Railroad Commission regulate the rates and service of the Tuolumne County Electric Power & Light Company.

The Pacific Gas & Electric Company applied for permission to devote a portion of the proceeds received from the sale of its last issue of $5,000,000 of bonds upon the enlargement of the Bear River Canal. This canal will carry water from Lake Spaulding reservoir and will make it available for irrigation purposes in Placer county.

An order was issued extending until March 10th the effective date of a previous order authorizing the physical connection between the Pacific Telephone & Telegraph Company and the Tehama County Telephone Company and the Glenn County Telephone Company.

March 4.

A supplemental order was issued allowing the Southern Counties Gas Company to issue $5500 of bonds under a previous authorization.

March 5.

The Pacific Telephone & Telegraph Company applied for authority to install a telephone plant at Greenfield, Monterey county.

The Great Western Power Company applied for a certificate of public convenience and necessity to serve Yuba county and the city of Marysville with electricity.

ALPHABETICAL INDEX TO ADVERTISERS

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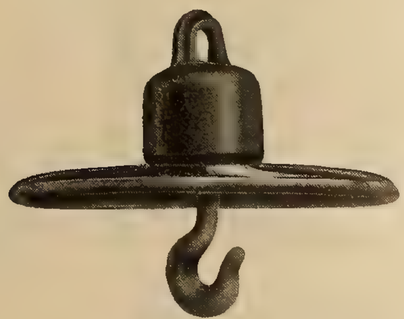

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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HYDROELECTRIC STARTING-UP EXPERIENCES

BY LLEWELLYN EVANS.

"At the Power House, When the Water Was Turned in, the Tailrace Was Two-Thirds Full of Mud."

For those who have not read the article of description of the Tacoma Municipal Power Plant, appearing in the Journal of Electricity, Power and Gas of March 1, 1913, we would describe the development to consist of a diversion dam, a two-mile tunnel across a bend in the Nisqually River, a concrete reservoir, and the four penstocks dropping down into the canyon with 425 ft. head, and connected with four 5000 kw. turbine units, which supply current to be transmitted thirty miles by duplicate transmission line to Tacoma.

Gates.

The first apparatus in connection with this subject to be tried out were the ten gates about the reservoir. Two of these are for waste gates, two for bypass gates, four for forebay gates for the penstocks,

and two for wash out gates. They are all uniform in size with a six foot opening, and are made of cast iron with bronze bearings fitted water-tight. After these gates had been placed and left by the machinist in apparent working order, several weeks' work was necessary on them a few months later in cleaning the guides, screw threads and gears. While at first it was practically impossible for several men to operate the gates by hand, and impossible for the motors to move them, after all careful adjustments were made and everything cleaned up and oiled, one man could easily operate the hand levers and the motors gathered speed on the first notch.

It was found that with just a few inches of water behind them the gates leaked profusely. As soon as they were covered with sufficient water to cause some pressure there were no leaks. The gearing of the gates was designed to accommodate limit switches for disconnecting motors at the end of travel, but these switches were omitted as the installation was carried out, and it was found that the over-travel of six inches top and bottom gave sufficient time for the operator to stop the gate, and also that when the limits were over-run the progress of the motors was automatically cut out by the overload breakers.

The controllers of all but the forebay gates are hand operated. The adjustments to be made on first starting were to set the hand wheel starting lever point so that the off position was horizontal, and travel upwards raised the gates and travel downwards lowered the gates. For the temporary source of power all the motors were set to run in the same direction for the same position of the starting lever, so that when the permanent source was connected in, it was just a matter of reversing one phase to turn all the motors right side up.

The forebay gate motor controllers are solenoid operated in successive steps and form the first relay by a contact button. There were no entanglements to unsnarl, except that dirty stop-contacts caused considerable trouble in locating the fault as such, the trouble being intermittent. The small contact points were not sufficient to insure true connections and their failure came nearly proving disastrous when the first water was turned into the reservoir. It happened that the temporary telephone system between the intake and the reservoir having failed to work after the signal was given to turn water from the tunnel, and with the river full in the channel behind the spill wall the reservoir started rapidly to fill up, while all of the forebay gates were yet open and the men working in all of the pressure pipes. On failure of the motors to operate, they worked frantically on the last gate to close it by hand while the fault was being discovered, when it was but a moment's work to run the gate down by power, and the water was just trickling over the weir wall in front of the forebay pipes when the gate was swung into place. This would not have been so serious a matter had the wash out gates operated smoothly, but due to incompleted adjustments, only one could be opened a short distance, and not sufficient water could be turned into the waste channel to keep up with the in-rushing water. Such emergencies would never occur in the regular operation of the reservoir, because when everything was in working order the equipment worked smoothly. After the first water had been turned from the reservoir through the washout gates, water was admitted into the forebay compartment behind the weir wall through the by-pass tunnels under the reservoir direct from the conduit at the entrance to the reservoir, and the first water was turned into the penstocks by opening the small 12 in. by-pass valves by hand, and allowing the stream of water about four inches deep to run down the pipe and gradually fill it past one supporting pier at a time to test them. Throughout this filling process riveters and caulkers watched the pipe line for leaks. Of course no pipe line can be expected to be tight at the first trial. The leaks found, however, were not serious and were limited to sand holes in flanges, with but slight leaks in the rivets and along seams. Many of these leaks closed themselves after a week under pressure and others were easily closed with a caulking tool.

At the power house when the first water was turned in the tailrace was two-thirds full of mud and large embankments of excavated material stood up in front of the relief valve outlets. The first water turned into the turbines showed a remarkably tight job. The turbine casings would not be known to contain water. The smaller piping, unions, ells, etc., around the automatic relief valve and by-pass were not near so fortunate and this work kept the turbine crew many hours to get tight. The adjustment in clearing out the automatic relief valves was particularly a toilsome job, for the penstocks had not been cleared carefully, and overalls, rocks and scaffolding kept collecting for a week or more in the relief valves and exciter nozzles. The first water which came through the automatic relief valves soon disposed of the muck heap in front of them. When the valves were turned wide open, the 425 ft. head of water ripped down the mounds of earth as if the relief openings were giants purposely designed to do it. The tailrace muck was considerably slower in disappearing, because little water was required to turn over the turbines without a load which was not at that time available. However, all water that did pass through the tailrace contained a large percentage of silt, so that the closed area soon became a safe opening. The two main bearings of each machine ran without perceptible rise in temperature from the start; the water-cooled jackets and a self-aligning feature making this almost a certainty.

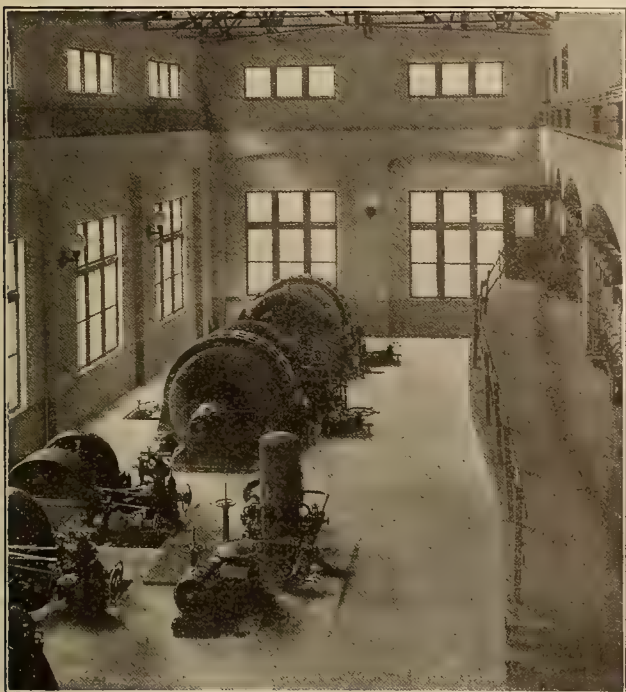
Exciters.

The exciter units were the first to be put into service and much trouble was experienced with debris lodging in the nozzles.

The governors took care of the speed in excellent style from the first, only slight adjustments for sensitiveness being made.

As the exciters were direct connected right handed and left handed to the Pelton wheels, when they were first started it was found that their compoundings were connected opposite. With insufficient load for testing it was practically impossible to determine which was compounded correctly and much needless time was lost, for as soon as a three-quarter load was obtainable the generator which was com-

pounded wrong showed a drop of about fifteen volts, while the one which was compounded correctly fell off only five or six volts on application of the same load. To straighten out the compounding it was necessary to reverse the connections to the brushes. This required three or four hours of mechanical work and adjustment. The matter of change of polarity was



"The Exciter Units Were the First to Be Put Into Service and Much Trouble Was Experienced With Debris Lodging in the Nozzles."

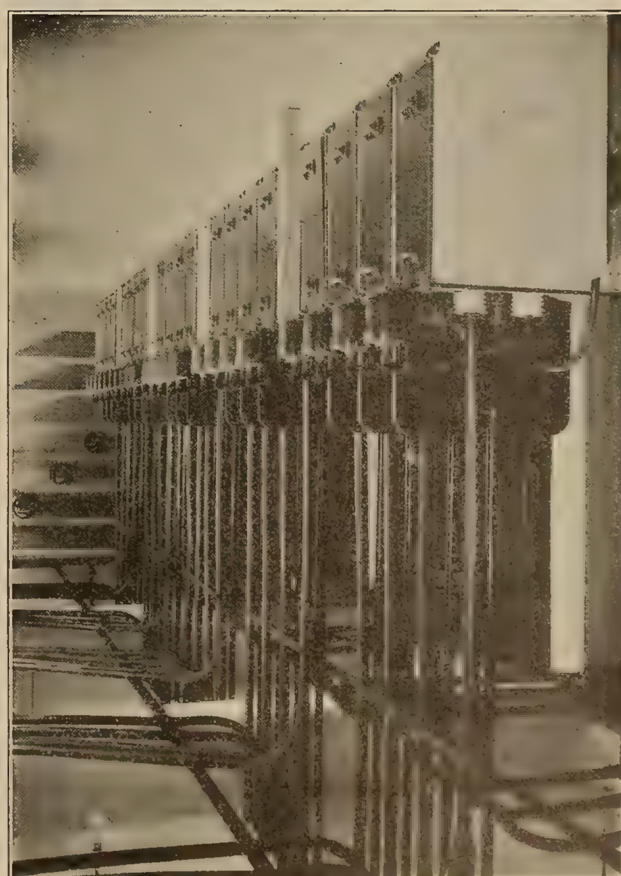
easily accomplished because both field wires ran to the switchboard and could be connected to the field switch of the other exciter for magnetizing current. It was a week before steady running could be depended upon because of stopping of the nozzles with debris from the penstocks. To clear these nozzles it was necessary to take off housing or remove the needle valve. The erector could have saved himself endless trouble if he had crawled through the penstocks and inspected it himself, instead of depending on the steel workers.

D.C. Meters.

As soon as the exciters were in commission the work of trying out all d.c. apparatus commenced with the meters. About half of the meters recorded backwards and had to be reversed. When the controls of the graphic meters were tried out, it was found that, through some mistake, the responsibility for which could not be located, the control coils while wound for alternating current were connected with the direct current circuit and several were injured before the fault was discovered. The d.c. meters were practically all in good calibration.

Remote Control Switches.

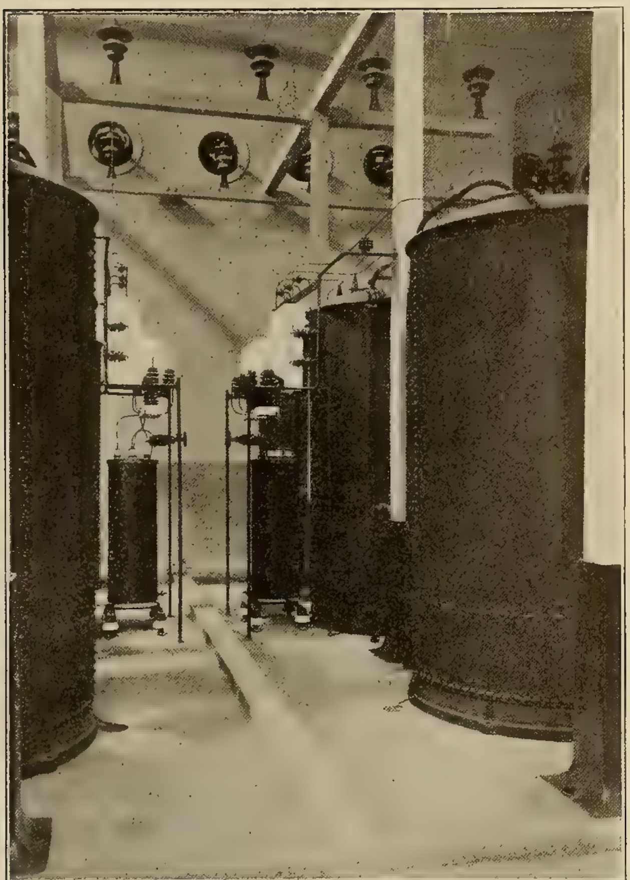
The adjustment of the main exciter switches, which were of air-break type, was a job of oiling and spring adjustment. There was a tendency to stick in the off position and to drop out of the toggles on the in position with high voltage operating current, but patient adjustment with continuous trials put them in excellent running order so that they would operate 25 per cent above and below normal voltage. The air-brake solenoid switches for the fields of each generator required similar attention and careful adjustment by trial. Before the main circuit-breaker switches had been carefully adjusted a couple of small accidents occurred to the switchboard, due to opening of this main breaker with field load on the bus. While each of the generator field switches are provided with field discharge resistance, the main switch is not, so that with three or four generator fields on the main bus accidental tripping of the main switch caused the discharge to jump over at the indicating lamps of the several control switches. At one time the fuses for all of these indicating lamps burned out, and another time all the lamps that were in circuit were burned out. This feature was not made accident-proof, but with care on the part of the operators to throw out field switches first, no such troubles could be repeated. The adjustment of the type "C" Westinghouse oil switches for 6600 volts proved to be a lengthy job. While all contact points had been adjusted in erection so as not to slip a thousandth of an inch, and the tension on the contacts reduced to the finest point, there was still the adjustments of the backlash and solenoid core positions to be made. It was found that while the switches would go in excellently at



"The Adjustment of the Oil Switches Proved to Be a Lengthy Job."

100 volts, that at 130 it would drop out at every attempt to operate the circuit. By adjusting the position of the core of the solenoid so that there was still strain on the mechanism when the core touched the bottom and by careful setting of the limit screws

by trial this rebound was eliminated. Out of nine switches only two would stay in at first, but after one switch had been adjusted for the particular conditions it was a matter of but a few hours' work to put every other one in similar condition. The completion of the adjustment of these switches made operation certain between the limits of 100 and 137 volts. An attempt to operate the switches at 90 volts, even with the most delicate balancing of parts, was unsuccessful. The normal rating of the switch is 125 volts.



"The Transformers Were Dried With Hot Air Forced Through Them by a Fan."

The nine type "GA" Westinghouse oil switches for 60,000 volts presented similar problems except that considerable more difficulty was experienced in getting the first switch adjusted. This switch is slower in action and much more powerful, and the greatest trouble experienced was the re-bound as the switch finished its motion, the toggle mechanism being provided with a hook which fell into place by gravity as the switch came into position. Since the gravity toggle was slow in action, it was a matter of tuning the switch up, so to speak, in order that the hook would just catch the toggles as the switch struck the limits. Filing of hooks and adjustments of the length of the spring contact seemed to give no results, until it was found that more tension on the contacts was needed. After adjusting for additional tension and settling the limit screws to a fine point, the first switch operated throughout a range of 80 to 137 volts. The time required to go in at 80 volts was four-fifths of a second. This is the time between the throwing of the drum handle and the lighting of the indicating light on the switchboard. After the first switch had been thus carefully adjusted to the conditions, the remaining switches were put into service in a few hours.

Transformers.

The transformers were dried with hot air forced through them by a fan, the air being heated with a coke fire. Three transformers were treated at a time. Immediately after the drying process was stopped, the oil was admitted by a pipe line down the hill from the tank cars. The voltage test was made on these transformers long before any other apparatus was tested, current being supplied from the temporary plant. The trial was void of excitement, except such as was caused by poor telephone connections with the plant and blowing of a few fuses.

Generators.

While testing out leaks, all the generators had been turned over slowly, and as soon as the exciters were found to be reliable, the drying out of the generators was started. A short circuit, consisting of heavy cable, was put across the main low tension bus and the generator turned over slowly with disconnecting switches and generator oil switches thrown in. The exciter voltage was then built up gradually until about load and one-half was indicated on each phase of the generator. The thermometers placed in the windings were watched carefully, and it was found necessary to increase the current beyond the scales of the meters in order to get a drying temperature. The load was maintained at a point so as not to injure the windings, although at one time 92 degrees C. continued for some hours. The drying process lasted about thirty-six hours, two of the generators being dried at a time. As soon as these two machines were dry, a full speed test run was made to make sure of the bearings and all moving parts. The water-wheels which were furnished by the Allis-Chalmers Co. being of the single discharge type were provided with multi-step thrust bearing, which attracted considerable interest because of the uncertainty as to the lateral pressure these bearings would have to take care of. It was found that no excessive temperatures occurred. The only difficulty experienced in the large parts of the turbine were with some unsuitable packing chosen for the main shaft. The first one of these to go up in smoke caused considerable excitement until it was discovered just what was going on.

The first current generated was for the purpose of running the local equipment to replace the temporary plant which was shut down at the headworks. For several days one generator carried the operation of pumps, tramway and lights around the plant, and during this time meter men calibrated the alternating current instruments.

The first current to be sent over the wires to Tacoma was on November 5th, when the city's pumping plant, which could be connected direct to the high tension line without going through the substation, was operated for some hours to try out the transmission line and generators. Only hand regulation was used at this time, and there were no eventful experiences, everything running as it should. The city officials after this trial soon became anxious to undertake carrying their own load so as to discontinue the purchase of current as soon as possible, and although but a part of the equipment was ready, the long run

which has continued ever since was commenced, and from then on all adjustments and alterations had to be made with the risk of "spilling" the load.

Tirrill Regulator.

A complete description of the putting into commission of the Tirrill voltage regulator for this equipment would require a re-print of most of the pages of the instruction book which comes with the apparatus, for in this case the generators and exciters were supplied by the Allis-Chalmers Company, the equalizer rheostat and exciter panel by the Westinghouse Company, and the Tirrill voltage regulator by the General Electric Company. The dividing up of the two exciter rheostats into ten equal parts could not be done until the limiting positions were determined by trial, and stop watch, and the limiting positions on the generators could not be determined until after they had been started, so that the Tirrill regulator was the very last thing in service, and the last finishing touch was not completed until about ten seconds before the current was first turned into the line to light the city of Tacoma on a Sunday morning during church services. Good luck in this first preliminary adjustment made a voltage chart like a straight-edge for the first few hours. Afterwards, complete adjustments were required when different conditions of load and regulation were encountered.

Notable among the special experiences with this regulator are the fact that, while the limiting range of voltage of the generator was obtained with the generator rheostat about half in, the best operation of the regulator was obtained with all resistance of generator rheostats turned out. The exciters, while supposedly alike, and of the same speed, would build up or drop down their voltage in different lengths of time for the same change in rheostat positions. With half load on the generators, which was a normal condition, the exciter voltage kept at about 80 volts. It is this condition of low voltage which makes it necessary to have a storage battery, or some substitute for operating the solenoid switches. It had been hoped by the designers to avoid this battery requirement. Without this battery equipment at the present time the operating crew are having considerable inconvenience in switching and synchronizing.

The first current thrown on the line at the pumping station proved to be of the wrong rotation and the current was reversed by changing the cables in the generator pits. Phasing out the several generators was accomplished through synchronizing lamps connected through the potential transformers after testing out the wiring of the potential transformers to the switchboard to be sure of correct connections. Some time was lost in phasing out the last two generators, due to the fact that one potential transformer was partially burned out and gave a wrong reading. It was found that this transformer had been used in the temporary plant and had been half filled with water, which readily accounted for its poor condition. With all the machinery running successfully with hand control, the governors were tried out one at a time with one or two exciting experiences, notably the main bearing of one governor froze up and the machine ran away to its maximum speed. The operators had some excellent experience as to how to get a machine back to hand control without wrecking the plant. The generators were built to stand the run-away speed, but the pumps of the station in Tacoma could not keep up the pace and dropped off the line. An experienced switchboard man hung to his load with no intention of dropping it, and as the Tirrill regulator hung to the voltage the light customers in town never heard of the experience. The tachometer went beyond the range of the dial and so did the frequency meters. The governors, after being broken in and carefully adjusted are giving very high class regulation. The recording instruments of the substation showed better frequency charts than formerly.

Power Factor Meters.

Each generator is provided with a power factor meter. Correct connection to give the true power factor of each generator circuit proved somewhat elusive for the first week. After sufficient load was obtained connections were soon straightened out. The connections as made, following wiring diagrams from

"Half of the Meters Recorded Backwards and Had to Be Reversed."

the factory, caused the instrument to record in the wrong quadrant. Reversing of the potential leads brought them back in the correct quadrant, but with a tendency to indicate an increasing power factor while it should be decreasing. The reversal of current leads was to put the instrument in the wrong quadrant with the proper rotation. Insufficient load would allow the instrument to read almost anything, so that true readings were not obtainable until practically two-thirds load was on and two generators could be run in parallel and their power factors varied by shifting the field rheostats and load. After cleaning up the indicating meters, the recording instruments were even more troublesome, there being two instruments provided, each connected so as to record the power factor for a pair of generators. The current transformers were connected in parallel, but it was found that the best way to get the meters working right side up was by trial, after making sure there was sufficient load to get true readings. The first unsuccessful attempts were due entirely to lack of load. This is a second instance on the adjustments of the plant where much time could have been saved by waiting until sufficient load to give true readings was obtainable.

Spilling of Load.

At two times the load was dropped by accident. One occurred when it became necessary to adjust relays in the substation, the meter-man mistaking the current binding posts for the trip circuit and shorted out the wrong pair. The second occurrence was in trying to parallel the two exciters so as to shift the load from one to the other, one pole of the incoming exciter switch failed to go in and as the operator found it impossible by juggling the rheostats to throw the load to the new machine, he decided he would just trip out the old machine and the new one would have to carry it. This could have been avoided even with this remote control switch by noting that both a red and green pilot light were burning. This spill was somewhat disastrous to the indicating lamps and fuses on the board, as the generator field discharge went through them.

Transmission Line.

The transmission line showed neither grounds nor shorts in starting nor at any time since, although there was some fear of this, due to the fact that hunters had been using the insulators for targets during the period when the line was not operating. At the present time there seems to be no reason to regret the use of aluminum cable, as no lines have been down.

While this article has to do particularly with troubles, the job as a whole was unusually devoid of seriout trouble, due largely we believe, to the fact that only tried and standard apparatus was used, and that a specialist took care of each detail. Now that the plant is completed and been operated for three months, many of the far-sighted decisions of the original engineers can be appreciated, with low operating cost particularly noteworthy. The headworks requires only one man who takes all shifts, the reservoir and its gates together with the operation of the passenger tram require but one man for all shifts. The plant requires one switchboard operator and one oiler for each of three shifts, there being one man who fills the position of chief operator and resident superintendent. The transmission line requires a patrolman stationed at each end of the line and one at the middle of the line. At the substation the city employs the same men they formerly employed when purchasing current.

MONOGRAPH ON FOREIGN ELECTRICAL INSTRUMENTS AND METERS.

The ever-increasing use of electricity has made the manufacture of electrical instruments and meters an important and highly specialized industry, with many complex problems. In view of this fact, the Bureau of Foreign and Domestic Commerce dispatched Mr. H. B. Brooks, an expert of the United States Bureau of Standards, as commercial agent to make a study of this industry in Europe, where much pioneer work has been done in electrical measurements. Mr. Brooks visited the principal manufacturers and obtained such information in regard to their organization, methods and products as would be of interest to American makers and users. In his report, which has recently been issued by the Bureau of Foreign and Domestic Commerce as Special Agents Series No. 66, the works of 31 leading European firms are described.

ENLARGING THE BEAR RIVER DITCH.

BY RUDOLPH W. VAN NORDEN.

(Concluded.)

General Characteristics of Ditch.

For the first four or five miles, the canal follows closely the steep bank of Bear River, and when first constructed, consisted largely of wooden flume, the timber being cheap and easily accessible. The remainder of the canal was a ditch in earth and was, as may be seen by a glance at the map, a very crooked affair, necessitating a mileage about double the airline distance between the intake and Auburn. It was remarkably located for grade and safety of construction, as 60 years of continuous use has proven. While there are many stories told, and even to this day may be seen evidences of canal failures through faulty location and survey, this canal was well designed. As the flumes depreciated, many sections were replaced by ditch, although a few remained, and in the enlargement this type of construction has been maintained.

In the old line there was but one tunnel—this known as the Ragsdale tunnel, named from a pioneer employee, whose property the tunnel passed through. This tunnel is largely in rock, although there is some timbering. It has a length of 1377 ft. The grade of the canal is remarkably uniform; for 5½ miles from the intake it is 5.8 ft. per mile, the next 8½ miles has a grade per mile of 2.75 ft., and the lower end varies somewhat, but averages 3.7 ft. per mile. The old ditch has a trapezoidal section, the bottom width being 5 ft. maximum, the top width, 8.5 ft., while the depth below the berm averaged 4 ft.; the depth of water was 3 ft. The sides had a slope of 1 horizontal to 2 vertical. The flumes, which were of typical California construction, had an inside width of 5 ft. and a depth of 4 ft.

Foreign Labor Problem.

The problem was one of works organization. For this purpose, the work was put into two divisions—the first, extending from the intake, a distance along the canal of 11.3 miles, while the second division has about the same length, following the altered line.

There were established, along the line of canal, ten camps, and at New England Mills station on the railroad, a storehouse and receiving camp, all operated by the company. Four of the canal camps have compressor plants to supply compressed air for the work, and one, known as the Applegate camp, being a headquarters for the lower division, established in a farmhouse bought by the company. There are several camps for Greek and Turk laborers, who run them themselves. At Colfax the company headquarters was established in a commodious office building, from whence the engineering work is directed and which is also headquarters for the upper division.

While there is always a more or less migratory movement among the laborers, there has been little difficulty in keeping full crews, except during a few days in January, when the weather was unusually cold. Laborers receive a uniform wage of $2.50 per day and, except in the camps where they attend to their own mess, pay the usual price of 25 cents per meal.

The use of Southern European labor has been very successful, both Greeks and Turks giving satisfaction. Of course, for the peace of mind of all con-

cerned, the nationalities are not mixed, each having their own camp some miles apart. One often hears adverse comment on the labor value of these people, but it was soon learned by these laborers, particularly the Greeks, that the pernicious practice, which has unfortunately prevailed to a greater or lesser degree in California, that of having to "buy his job," by paying a regular percentage of his pay to the foreign" boss," who in turn shares with the foreman or whoever may have control of the hiring of the men, would not be necessary or tolerated by those in charge of this work.

Portable Boiler Outfit Supplying Steam to Burleigh Drills.

This has caused a state of mind among the foreign element which has had a remarkable stimulating effect and may be a reason for the good results obtained in comparison with the work at other points.

The greatest number of men at work at one time was in December, when there were about 2300 all told.

A record of work done and the men employed during a week in January on the upper half of the canal, follows:

	For Week.		Daily Average.	
Excavation:	Cubic Yd.	Lin Ft.	Cubic Yd.	Lin. Ft.
Hand excavation	14,585	4,850	2,080	692
Steam shovel excavat'n.	10,259	3,420	1.468	489
Force:				
Engineers		16		
Accountants, clerks, etc.		20		
Foremen		25		
Mechanics		221		
Laborers		1,470		
Total		1,691		
Head of stock		100		
Men per foreman		67		
Steam shovels		3		

With this comparatively large and unusually well organized force the time limitation for the completion of the work is not a source of anxiety, as, at this time, nearly a month before water must be turned in, the work, with the exceptions of the tunnels, is practically complete.

Bridges.

The great size and width of the canal makes the overhead road crossing assume the importance of a bridge of no mean dimensions. There are 6 bridges where county roads cross the canal. Part of these are straight and part skew. They are of reinforced concrete in a single span and have three beams, 20 in. deep and 12 in. wide, while the floor of the bridge is a reinforced slab, 10 in. thick. An ornamental concrete wall railing is provided on both sides of the bridge.

Method of Excavating.

Excavation has been done by hand and scraper and by steam shovel. In the beginning of the work, a big start was made by handwork before it was possible to get the steam shovels on the job. This has probably caused the total cost of the work to be higher than it might have been if the shovels had been introduced earlier, but was justifiable from the absolute necessity caused by the limited time available.

The material excavated is of all sorts. There is very little that is not in part, at least, rock, and much that was practically solid rock. Much hardpan, or disintegrated rock necessitating blasting was encountered. There are sections where a clear gravelly clay practically free from rock was found, and at these places the work progressed very rapidly.

The method of operation while excavating by hand was to commence the cut on the upper bank, either by pick and shovel, plow and scraper where the ground slope would permit, or by drilling and blasting. With handwork the earth is taken out in layers until the bottom of the cut is reached. Blasting was very carefully done, low percentage dynamite being generally used. The handwork while slower and more costly was neecssary in places where there was danger of shattering the outer berm by heavy blasting and the steam shovel.

There were four steam shovels used on the work. These are Marion No. 41 shovels with 1½ yd. dippers. The work of blasting preceded the shovel, the holes being drilled to the bottom of the cut and the broken soil as the result of the blast being allowed to fill the old ditch. The shovel takes out the spoil without difficulty, leaving the section fairly to gauge. It is then necessary to follow with hand labor to trim the cut to template.

The company was fortunate in having a number of good dry wall builders, and these men have placed a remarkably permanent and smooth wall in the lower berm.

Much ingenuity was necessary to get water and fuel to the steam shovels. Wood was purchased and cut at various points and was hauled along the bottom of the canal by three horse teams to the shovels. Water was piped in various ways from any available source. In one instance a gasoline pumping plant was installed in the bed of Bear River.

An innovation was introduced on this work at one point in the shape of Burleigh steam driven drills, supplied from a portable boiler. This boiler, a small one of the locomotive type is mounted on wheels which run on a temporary track placed on the canal berm. Water was hauled to a tank, also portable. No data is as yet available as to the relative cost of this expedient under the specific conditions however, it was satisfactory.

This work as well as the entire Lake Spaulding development is being done by the engineering force of the Pacific Gas & Electric Company and is under

the general supervision of Mr. Frank G. Baum. Mr. H. C. Vensano is civil engineer. For the upper half of the Bear River enlargement work, known locally as Division 3, Mr. G. C. Noble is the engineer in charge and Mr. James Martin, division superintendent of the Colfax water district of the company, is in charge of the construction work. In the lower section, known as Division 4, Mr. Paul E. Magerstadt is the engineer in charge, while Mr. D. H. Duncanson has charge of the construction work including driving the tunnels.

Typical Sections of Dry Walls in Enlarged Canal.

PURIFICATION OF GAS

BY E. C. JONES.

(Concluded.)

The amount of water used in washing gas ranges from 10 to 15 gallons per ton of coal carbonized. The ammoniacal liquor in the washer also removes a considerable amount of sulphuretted hydrogen and carbon dioxide from the gas. The effects of condensing and scrubbing on crude gas are about as follows:

*Gas.	H_2S grams per 100 cu. ft.	Ammonia grams per 100 cu. ft.	CO_2 per cent by volume.
Outlet Exhauster	610	231.1	2.57
Outlet Condensers....	590	196.4	2.34
Outlet Scrubbers	470	93.1	1.98
Outlet Rotary Washer	400	.37	1.58

*Mr. W. H. Fulweiler.

[1]Coal Tar and Ammonia by Geo. Lunge.

Only about 1/5 of the nitrogen of the coal is recovered as ammonia, and most of this during the latter part of the distillation period.

Ammoniacal liquor is usually sold by the gas companies to outside manufacturers, although some companies and many of the coke oven plants convert the liquor into ammonium sulphate and other products. The strength of the liquor is expressed in ounces, and refers to the number of ounces of real sulphuric acid required to neutralize each gallon of ammoniacal liquor. The Twaddell hydrometer was formerly used to determine the strength of liquor; each degree Twaddell corresponding to two ounces of strength, but this method is not reliable, and is much to the advantage of the purchaser. A better way is to use a standard acid solution, specific gravity 1.068, and for each 16 liquid ounces of the ammoniacal liquor the number of ounces of the standard acid solution used to neutralize it indicates the number of ounces of real sulphuric acid (H_2SO_4) required for each gallon of ammoniacal liquor. Litmus paper is used to indicate neutrality. The amount of ammoniacal liquor produced in the coal gas works varies with the quality of the coal, and the temperature to which it is subjected in distillation, and ranges from 13 gallons to 45 gallons of 8 ounce liquor per ton of coal carbonized. The usual amount is about 25 gallons.

A fair yield of ammonium sulphate per ton of coal is 20 pounds. The importance of this industry is shown by the world's production of sulphate of ammonia for the year 1912:

	Tons.
Germany produced........................	465,000
United Kingdom produced................	379,000
United States produced	165,000
France produced	68,500
Belgium produced	49,500
Austria-Hungary and the rest of Europe..	170,000
	1,297,000

The next step in the treatment of the gas is purification for the removal of sulphuretted hydrogen, organic sulphur compounds, and carbon dioxide.

The first efforts in this direction were made by Clegg when he mixed quicklime with the water in the gas holder tank at Halifax. This did not insure sufficient contact between the hydrate of lime and the gas to accomplish the expected result but in 1815 Accum, in a treatise on gas-light, described a lime machine which utilized a cream of lime as a purifying agent. This is the most efficient and economical form in which lime can be used for gas purification.

This method was used until the '50s, and its use was reluctantly abandoned on account of the difficulty

of disposing of the spent lime known as "blue billy.'

In conjunction with the milk of lime purifiers, a copperas washer was used. The general design of this piece of apparatus was the same as the wet lime purifier, but a solution of copperas in water was used instead of the milk of lime. The copperas washer was soon abandoned, but attention is called to it now because of recent demands for cyanides for the recovery of gold from low grade ores. The source of these cyanides is the cyanogen extracted from coal gas, and the process employed by Dr. Bueb consists in scrubbing the gas before its ammonia and sulphuretted hydrogen have been removed, with a solution of copperas in water. It has been found that the "Standard" scrubber is well adapted to treat the gas with copperas solution. The use of dry lime for purifying was invented by Reuben Phillips of Exeter in 1817, and on account of the convenience of handling and the easy disposal of the refuse, the gas engineer adopted a method which reduced the purifying value of lime from 14,000 cubic feet to 5000 cu. ft. per bushel of lime, thus over 64 per cent of the value of the purifying material was sacrificed to convenience, and to avoid nuisance.

In the days of Phillips, dry lime purification meant the passage of gas through a series of thin layers of lime powder in the purifier, which at its best would not extract the impurities from over 5000 ft. of gas per bushel.

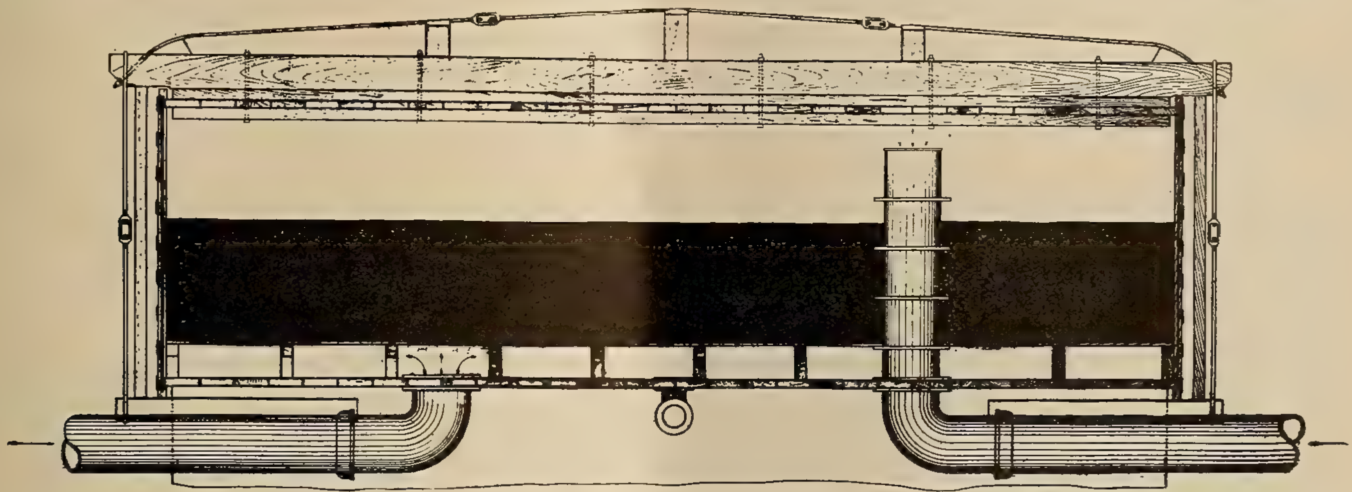
This method was used until 1875, wher Mr. Theobald Forstall of New Orleans taught the gas engineer to nearly double the efficiency of lime, and reduce the back pressure in the purifier by a simple method of treating the lime. More water was used in slaking the lime, and the slaked lime was passed through a wire screen which reduced it to granular pellets the size of a hickory nut.

The proper degree of moisture was found to be that beyond which any excess would cause the "dough" to adhere to the screen instead of breaking through. The dry lime weighed 60 lb. to the bushel, while lime prepared by this method weighs 92 lb. per bushel.

Lime purification removes the carbon dioxide, sulphuretted hydrogen, and organic sulphur compounds, and the spent lime in the boxes first in series removes the carbon disulphide. This is ideal gas purification, but the expense for lime and labor, and the provision of dumping ground for the waste material brought about a search for a less expensive method.

Oxide of iron purification was patented in 1840, and in 1849 a French patent was granted, which included mixing sawdust with the iron, and specifies that it may be revived by contact with the air and used again.

It was a hard struggle for conservative gas men to adopt a new method of purification which did not remove all the impurities although it promised a large saving in cost, but it began to be understood that a small amount of carbon dioxide was not very harmful in the gas, and that as long as no sulphuretted hydrogen was permitted to remain in the gas a reasonable amount of sulphur compounds did no harm, and so oxide purification was adopted.



Sectional Elevation of Jones Gas Purifier.

The material known as iron oxide is hydrated ferric oxide. This occurs naturally as bog ore or may be manufactured by rusting iron borings, or using copperas as a source of iron.

In the making of oxide of iron for gas purification, the proper amount of copperas for a batch to be mixed is placed in barrels and a very small amount of water added, the water of crystallization of the copperas being almost sufficient to liquify when the copperas is heated slightly by steam, steam being blown directly into the barrels. Sawdust sufficient for a batch of oxide is levelled off on the floor to a depth of about 8 or 10 in. The copperas in the amount of 20 lb. to the cu. ft. of sawdust is then poured over it and turned over until thoroughly mixed. Lime in the amount of 10 lb. to the cu. ft. of sawdust is then slaked to a consistency which will hold the form of a hand when a portion of the lime is squeezed. Half of the lime is then mixed with the copperas and sawdust, and the mass turned over and packed with the flat side of a shovel until no lime is perceptible. This is allowed to oxidize for 24 hours, when the second half of the lime is added in the same manner and is again turned over and allowed to oxidize. Before stacking as finished oxide, the mass should be turned at least five or six times to allow thorough oxidization, and to prevent over heating.

Formula.

Bushel.	Pounds.	Pounds.
1 Sawdust.	12½ Slaked Lime.	25 Copperas.

Or

Cu. Ft.	Pounds.	Pounds.
1 Sawdust.	10 Slaked Lime.	20 Copperas.

Iron borings rusted by a solution of sal ammoniac in water is sometimes added to advantage.

Until recently the accepted shape of purifier was a square pan-shaped vessel made of cast iron plates, and provided with a sheet steel cover fitted to a water seal, or lute joint, around the top of the purifying box. This joint is gas tight and saves much time over any method of fastening a cover by bolts. The area of the boxes is according to the capacity of the gas works, while the depth was at first from 3 to 4 ft. and is now increased to greater depths. The new purifiers at the Astoria Plant of the New York Consolidated Company are 40 ft. square and are 8 ft. in depth, containing 2 layers of oxide 42 in. thick each. Purifiers are usually arranged in groups of four, either in the form of a square or in a straight line, and as it is necessary to change the sequence of boxes for the purpose of renewing or reviving the purifying material, the course of the gas is regulated by a center-seal, (a dry seat revolving valve which connects three boxes in regular sequence and completely shuts off the gas from the fourth) or preferably by a system of valves so arranged that the sequence of the boxes may be changed at will and all four boxes used at one time. This method increases the purifying capacity of the works by permitting the use of the fourth box.

When lime was used to purify gas six thin layers (from two to four inches thick) were used. These were finally reduced to two thicker layers. Oxide of iron was first used in two thin layers, and as it became evident that the back pressure was not seriously increased by using thicker layers of purifying material, the depth was increased until modern purifiers are filled with oxide in one layer, from four to six feet deep.

The reactions of oxide of iron in removing sulphuretted hydrogen from gas are:

$$Fe_2O_3 + 3H_2S = Fe_2S_3 + 3H_2O, \text{ and}$$
$$Fe_2O_3 + 3H_2S = Fe_2S + S + 3H_2O$$

simultaneously and the proportion is 3 parts of the ferric sulphide and 5 parts of the ferrous sulphide.

Cyanogen when not removed combines with the iron forming Prussian blue.

The great advantage of oxide of iron purification over any other, is that after it has performed its work it may be revivified by bringing it in contact with the air, and it may be used and revived until the sulphur content reaches above 50 per cent of the weight of the purifying material.

It was at first the practice to remove the oxide of iron from the purifier each time after it had done its work and spread it on a floor, turning it until each particle had been revivified by contact with the air. An improvement on this method consisted in raising the cover of the purifier and drawing air downward through the purifying material by means of a steam jet exhauster, or a rotary fan exhauster. This method saves time and labor and prevents the breaking up of the oxide by handling.

Following is a typical analysis of spent oxide:

	Per Cent.
[1]Ferric oxide	26.71
Metallic iron	.06
Free sulphur	54.56
Prussian blue	2.56
Tar	4.11
Wood shavings	12.00
	100.00

[1]Mr. W. H. Fulweiler.

The period of revivification is from two to four hours, at the end of which time the material is ready to be used again.

Air should be drawn through the purifying material and not blown through it, as blasting causes local revivification with the generation of heat so intense as to set fire to the oxide.

It is customary in many modern gas works, and it is recommended by eminent authorities, to revive the oxide of iron in place by admitting a small quantity of air at the inlet of the purifiers. The air provides the necessary oxygen to continuously revivify the purifying material without taking the purifier out of use. The amount of air necessary is from 2 to 2½ per cent of the volume of the gas. One authority states that from 0.5 to 0.7 per cent of oxygen is theoretically needed for the continuous revivification of oxide. The discovery of a method of producing cheap oxygen would at once make this an ideal method of revivifying oxide.

The latest type of purifier adopted by the larger gas works in California, is a series of round wooden boxes made of redwood staves. These boxes are 30 ft. in diameter and 9 ft. deep. The top of the boxes is covered with water to a depth of about 2 in., and grooves between the staves connected by holes passing through the staves provides a system of water soaked gas tight boxes. The heads of the boxes are of redwood, and doors are provided on the top head and at points on the side for filling and emptying, and for the admission of air while revivifying. The oxide of iron is placed on wooden girds, in one layer of any desired thickness. It is customary to use a layer from 5 to 6 ft. deep. These boxes have a daily purifying capacity of one million cu. ft. of gas each.

After leaving the purifier, the gas passes to a station meter where it is measured and is then stored in the gas holder ready for distribution.

HYDROELECTRIC DEVELOPMENT IN PRUSSIA.

The British embassy at Berlin states that a bill has been laid before the Prussian Diet for the development of water power on the upper waters of the Weser. It provides for an expenditure of $2,142,000, of which it is proposed to spend immediately only $1,190,000 on the erection of power stations at Hemfurt and Helminghausen; the remainder will subsequently be spent on the construction of a power station at Munden. It is estimated that the three stations can produce 41 million kilowatt hours annually.

ELEMENTS OF STEAM POWER PLANT DESIGN

ADVANTAGES OF HIGH VACUUM AND SUPERHEAT. IV.

BY C. R. DELANEY.

Since the introduction of the steam turbine into power plant work, the condensing equipment has assumed much greater importance than it formerly possessed. The reason of this is that a steam turbine is able to utilize a much greater degree of vacuum than a reciprocating engine. With the usual proportion of cylinders in a compound engine, the maximum ratio of expansion of steam in a reciprocating engine is not over 20:1. In the case of the steam turbine on the other hand, we have a ratio of expression of 120:1 operating with a vacuum of 28½ in., or if the vacuum is increased to 29 in. the ratio of expansion becomes 180:1. You are all famiiliar with indicator cards of reciprocating engines. It is customary for the designer of reciprocating engines to draw a theoretical indicator diagram, plotting the volume of the cylinders as abscissae and absolute pressure of the steam as ordinates. This diagram enables him to study the various operations of the steam in the cylinders; the point of cut-off,

Fig. 1. Illustration of Impracticability of Pressure Volume Diagram for Turbine Design.

release, compression, etc. Fig. 1 shows a similer theoretical diagram made for a steam turbine. In this case, instead of laying off the volume of the cylinder on the diagram, I have laid off the volume of one lb. of saturated steam. You will at once see that owing to the large volume of the steam at high vacuum, it is necessary to use a very large sheet in drawing the diagram, as with the diagram drawn on an ordinary sheet, the scale is so small that it becomes practically useless. For these reasons it is customary for designers of steam turbines, instead of using the pressure volume diagram, to make use of the temperature entropy diagram, an example of which is shown in Fig. 2.

Entropy is an imaginary quantity defined as 'he quotient of quantity of heat divided by absolute temperature, consequently if we lay off entropy as the length on a diagram and absolute temperature as th height, then the area of the diagram represents quantity of heat or the amount of energy available between any two conditions of expanding steam. The use of entropy diagrams simplifies calculations and makes it possible to use graphical methods in cases where the pressure diagram would be useless.

The diagrams reproduced in Figs. 1 and 2 were made for the purpose of ascertaining the proportion of work done in the several stages of a Curtis steam turbine. The pressure volume diagram (Fig. 1) was first made, and horizontal lines were drawn corresponding to the pressure in the different stages. An attempt was then made to measure the area of each portion of the diagram, but owing to the great length of the diagram in proportion to its height in the low pressure end, and its great height in proportion to its length in the high pressure end, it was found that the slightest inaccuracy in drawing the diagram led to considerable error in the final results. The use of this diagram was therefore abandoned, and the Temperature Entropy diagram was adopted in its place. A glance

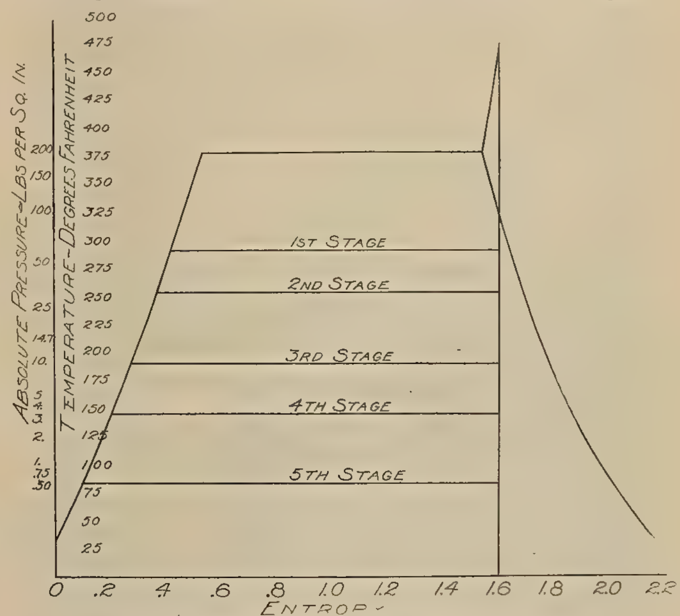


Fig. 2. Method of Determining Work of Steam in the Various Stages of a Steam Turbine by the So-Called Temperature-Entropy Diagram.

at this latter diagram (Fig. 2) shows that at the time the readings were taken the first stage was doing more than twice as much work as the second, and the third and fifth stages were also doing more than their share of the work. Certain adjustments were made which corrected this condition, so that diagrams made at a later date, showed an equal distribution of load among the different stages, and in consequence better results were obtained from the turbine. Thus the temperature entropy diagram may be used in making adjustments on a steam turbine, just as indicator diagrams are used in setting the valves of a reciprocating engine.

A study of entropy diagrams indicates at once the great value of high vacuum in connection with the operation of steam turbines. At the time the diagram shown in Fig. 2 was made the vacuum was 28.8 in., corresponding to a steam temperature of 85 degrees F. Had the vacuum been only 26 in., which is considered good practice for reciprocating engines, the steam would not have expanded below the dotted line AB,

which corresponds to a temperature of 125 degrees F., and all the energy represented by the area A, B, C, D would have been lost. It is found in actual practice that an increase in the vacuum of 1 in., say from 28 in. to 29 in. reduces the steam consumption of the turbine almost 7 per cent and is as effective in this respect as an increase of the steam pressure of 70 lb. This reduction in steam consumption per kilowatt hour means not only a material saving in fuel but also will result in an increase of capacity of the whole station. Steam turbines are designed with nozzles of suitable size to admit the proper amount of steam for maximum capacity for which the machine is designed. It is use-

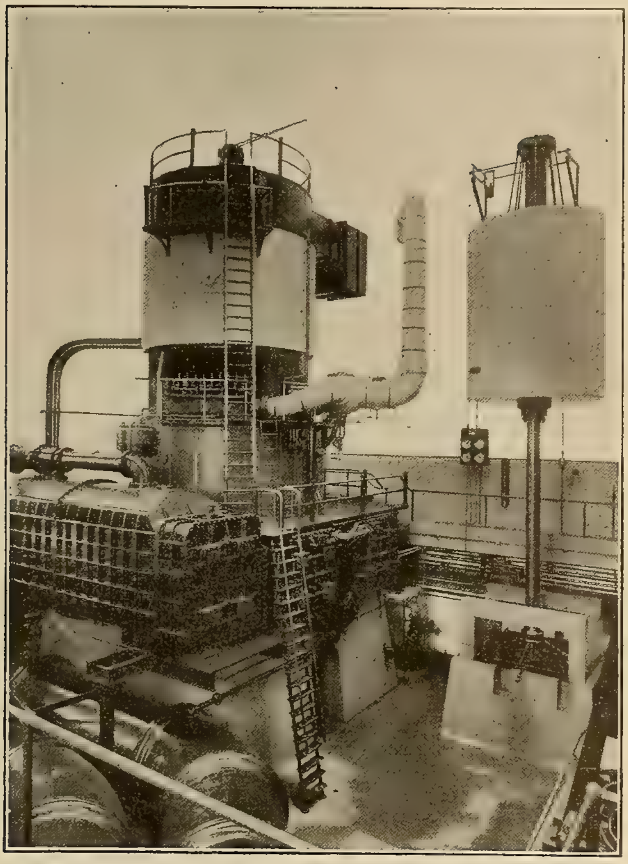


Fig. 3. 12,000 kw. Curtis Turbine With Base Condenser and an Additional Auxiliary Condenser in Separate Shell.

less to supply more steam to the turbine than this maximum, as it simply will not pass through the nozzles. Consequently if it is desired to carry a greater load on the machine, it is necessary to look to the low pressure end for relief rather than the high pressure end, and by increasing the vacuum we find it possible to increase the capacity of the machine by an amount equal to the per cent of increased efficiency due to the higher vacuum. In some cases an increase in the vacuum may save the installation of additional boilers. Suppose for instance, a plant has not sufficient boiler capacity to operate the turbine at full load, a gain of 7 per cent on a 12,000 kw. plant due to an increase of 1 in. in the vacuum is equivalent to an increase in capacity of 840 kw., which otherwise would only be obtained by installing an additional boiler.

Superheated steam also has a marked influence in increasing the efficiency of steam turbines. Superheaters are usually installed in the boiler settings and in fact become integral parts of the boilers. The gases from the furnaces are made to pass over the superheater after passing over part of the heating surface of the boiler, and after leaving the superheater the gases travel over the remaining portion of the boiler. The advantage of superheated steam in the operation of the steam turbine, lies mainly in the fact that superheated steam is a rarer medium than saturated steam, consequently the friction of the rotating buckets of the turbine traveling through the steam at a high velocity, is less when superheated steam is used than with saturated steam. Another reason for the advantage of superheated steam is that the superheat increases the volume of the steam to a marked extent, and on account of the greater volume there is less leakage passing the ends of the blades in the turbine. In practice it is found that 100 degrees of superheat results in a saving of about 8 per cent in steam consumption. This is not all a net gain, however, as it takes more fuel to generate superheated steam than the same weight of saturated steam. The extra fuel required to superheat the steam 100 degrees amounts to about 5 per cent, so there is a net gain of 3 per cent.

WESTERN STATES COMPANY'S COMPLAINT DEPARTMENT.

The complaint department of the Western States Gas & Electric Company is probably the best equipped department of any public utility company in the West. A great many inquiries have been received from other utility companies for information concerning it and its operation. To one of these inquiries, A. G. Halloway, who is in charge of the department replied in part as follows:

"The policy of the department is to shape its attitude towards the public so that the patron is bound to feel that by simply calling attention to a real or imaginary wrong it will receive prompt attention. We feel that a patron making a complaint is honest in his belief that a wrong exists, and no matter how small the complaint or how trivial it may be, we go into it thoroughly. When a complaint is entered we are very careful to get the correct name and street number. We try to find out the cause of the trouble when receiving the order, thus enabling us to determine to whom the order should be sent for prompt execution.

We also keep a book entry of all complaints. We have a day trouble man and a night trouble man for both gas and electric departments. The night men turn in their orders each morning, in that way we are conversant with what has transpired during the night. I feel that I cannot place too much importance on the subject of handling complaints, the way the customer is received and the interest taken in his complaint. I believe the success of a complaint department depends chiefly on the man at the head of it. He must thoroughly understand the business, as he must necessarily deal not only with high bills, poor service, setting of or removing meters, adjusting overcharges, re-reading meters, opening and closing accounts and testing meters, but in fact settling any and all disputes. To do this the head of the department must be able to receive all complaints against the entire company in such a way as not to offend the customer."

ELECTRICAL PUMPING AND IRRIGATION

WASTEWAYS OR ESCAPES ON CANALS.

BY. B.| A. ETCHEVERRY.

Wasteways or escapes are used to turn a portion of the whole of the water from the main canal into the river or in some natural drainage channel. This is necessary when a break occurs in the canal or when an excess of water enters the canal. When a break occurs it is a big advantage to be able to divert the water out of the canal through an escape above the break. When no escapes are provided the water can only be stopped by closing the headgates. This usually requires considerable time to reach the gates and a longer time before the water already in the canal will drain out through the break; consequently the break will be much more serious. For these reasons it is very desirable to have wasteways at many points on the line and especially above those points where a break would cause the greatest damage, such as above long stretches where the canal is in fill, above flumes, siphons and other important structures. The most favorable location for a wasteway is where the canal passes near the river or a natural drainage channel. This will often be above the head of flumes, siphons or fills.

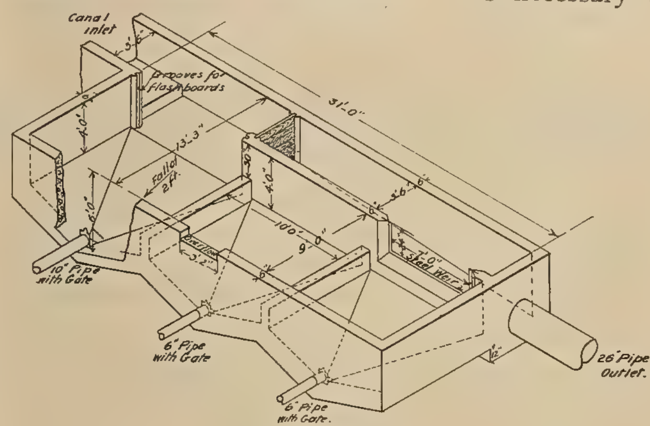
The structure will usually consist of (1) a cut made in the bank of the canal extending from the top of the bank to the floor of the canal or lower. A narrow cut may require only one gate, but a large one must be divided by piers or columns into a series of openings closed with gates; (2) a wasteway or escape canal which carries the water to the nearest suitable drainage channel.

If the floor of the escape openings is at the same level as that of the canal, when the gates are opened part of the water will pass through the gate openings, but another portion will flow on in the canal. The proportion depends on the total width of escape openings as compared with the size of the canal. To pass the entire discharge through the escape two methods are used: (1) The sill or floor of the opening is depressed sufficiently below the floor of the canal to make the entire volume of the water flow through the escape. (2) Check gates are used across the canal and the wasteway is placed directly above them. By opening the escape gates and closing the check gates the entire volume will be forced through the escape which must be of sufficient capacity.

Often the escape can be combined with one or more structures. It may be built with the inlet of a flume or siphon; it may be formed to serve also as a sandgate or may be combined with a drop and checkgate across the canal. The principles governing the design of the gates will be the same as those explained for headgates. The waterway, canal which has generally a steep slope, may be constructed as a chute or may require a series of drops. The design of these is considered farther.

Sandgates—Sandboxes.

Sandgates are intended to remove the sand and silt carried by the water and deposited in the canal. They can also be used as waste gates. The efficiency of sandgates is often very low and where possible it is much preferable to design the headgates so that little material will be carried into the canals and to design the canals so that what does enter the main canal will be carried to the fields. The difficulty in removing sand and silt is due to the following conditions. When the water entering into the canal carries silt and sand in suspension, deposits will form wherever the velocity falls below the transporting velocity of the material. To remove this material it is necessary to



Sand Box.

create by means of sandgates a scouring or erosive velocity sufficient to overcome the cohesion of the deposited particles. The normal velocity which has permitted these deposits is less than the transporting velocity and is very much smaller than the required erosive velocity, especially if the deposited material packs with considerable cohesion. It is difficult to create this higher erosive velocity and the effect of the sandgates is limited to the section of canal near them. In designing these structures it is necessary to know the character of the material transported, whether sand or silt. Sand is more liable to form deposits in the canal. It is transported on the bottom of the canal, the coarser particles rolling on the bed. Silt is more evenly distributed in the water and the finer silt generally should be transported to the fields where it may be of considerable value.

There are two general types of structures. The first one is better adapted to waters carrying sand. It consists of a sand trap which collects the sand as it moves near the bottom of the canal and discharges it into a waste channel. The second type is better adapted to finer material. It is formed by a depositing basin where the velocity of the water is reduced sufficiently to cause a deposit of some of the material, which is washed out through sluice gates into a waste canal or chute and carried to some drainage channel.

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NOTICE TO ADVERTISERS.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

With regard to the item on "New Water Code Provisions" on page 221 in our issue of March 8th. This should be credited to the State of Washington and not to the State of Oregon.

What picturesque visions flash by the thinking mind at the mention of the words "starting-up experiences"!!

Starting-up Experiences

Our leading article of this issue is interesting considered as a detailing of the many unforseen, pestering trifles and experiences which happen when putting into operation a new and high class hydroelectric installation. By its careful perusal it may serve its part in lessening such trying difficulties in the future. But the most forceful lesson one learns in following the many obstacles encountered in getting started upon a new task of this sort, is the symbolic applications that may be made to the initial steps in all new undertakings of the business and commercial world.

Let us consider for a moment some of these analogies. The hard-opening gate, controlling the supply of power developing water, illustrates the friction and inharmonious characteristics of a newly constituted board of managers, which in time by means of levers and careful inter-adjustments will allow to issue forth the life-giving orders that will control the energies of half a hundred industries. The countless leaks sure to spring forth as the penstocks swell with pressure may be likened to the many financial leaks and losses encountered before properly appointed systems of accounting and detailed checking are enforced to keep the energies of the company in its proper channels. The wrong compounding of the exciters remind us that in any business two energizing forces in management may be present, which if operating separately may each supply the vital fields of magnetization of action and yet when utilized in the same circuit of action they must pull in the same direction or little useful results follow. Indeed in the operating circuit the backward reading of meters improperly connected remind us that not only may energy be not registered or in other words be passive, but even negative output may be recorded instead of positive results.

The drying out of the transformers and generators, like the trying out of new men, often brings to light defects in construction and improper internal make-up. By a careful analogy of such starting up experiences we learn to avoid the hasty size up, both of men and material.

Difficulties in remote control switches, their oiling and spring adjustment, teach us the defects to be avoided in the lack of composite organization. The backward reading of alternating current meters due to the control coils being connected to the direct current meters tell us of the disasters that may follow due to the overlapping of authority. Lack of synchronism, too, in all of the workings may cause the load to spill as happened in the case at issue and happy is the business management which has the delicate yet powerful governor that can manfully steer the organization through the runaway experience that inevitably follows.

When serious thought is given to the starting or beginning of hydroelectric development in the West, how remarkably similar appears the early workings of this productive activity. The time of second thought being now upon us it well behooves the management of today to consider carefully all the experiences and vicissitudes of former years in launching new enterprises. Thus will be built up in these days of substantial growth the real assets and valuations that such enterprises merit.

The Bohunk Laborer and the Rake-off

The question of securing common labor is one that affects the hydroelectric fraternity equally as deeply as it does the railroad contractor and other outfits where human physical effort is required to perform the major portion of new development work.

The Turk, the Greek, the Montenegrin, the Servian, and the Bulgarian laborer, known throughout the West as the "bohunk," is usually paid his daily wage by one of his fellow countrymen after the said fellow countryman has deducted from twenty to thirty per cent for his professional services, and for the rake-off of the foreman, who is in addition fully paid by the construction company itself.

Oftentimes the leader of such a gang of foreigners is the only one who speaks English in any intelligent manner whatsoever, hence it is argued that since these foreigners usually depart at a later date for their own country and since ample supply of labor is thus assured this method of procedure is thoroughly justified.

To look at the average "bohunk" laborer one may easily imagine that he sees what may be technically described as simply a "physiog" and not a human face. Hence justification of the degrading rake-off instittuion is easily argued to the faltering conscience. The wrong, however, is not alone done to these human devils, because its greatest baneful effect is reflected in the attitude and ethical standard left throughout the corps of managerial workers who must stand by and suffer such practices to continue. Indeed its influence is not of such a passive nature. The rank and file of bookkeepers, timekeepers, straw bosses and other trusted employes of the company must have their standard of honesty and loyalty to the company correspondingly lowered.

Again, management of all affairs pertaining to public utility activity is now the subject of close and critical scrutiny on the part of the general public. Evolution in utility affairs strongly favors an open-and-above-board policy. The old day of "wink the other eye" and endeavor at the same time to maintain a reputation for honesty among the general public at large, has passed on with many other traditions of former days.

It is interesting to note that a large construction gang is now at work in the West upon a hydroelectric project, as detailed on another page of this issue, wherein the pernicious practices of the rake-off gang boss is wholly abandoned. The results are already perceptible in raising the standard of labor among such men.

Historians tell us that the three great ties that hold human beings together are community of race, community of religion and community of interest. Under the old regime the two former were maintained in the camps, but not until the common laborer can be impressed with the fact that he is getting a square deal is community of interest attainable. Thus, by maintaining separate camps for each nationality and by the laborer's enjoying the additional wage per day which formerly dropped into the gang boss's pocket, a result is accomplished in lessening the migratory movement of foreign help and in getting superior human effort during the hours of service.

Boiler Efficiency

There has arisen considerable misunderstanding as to the true meaning of boiler "efficiency." In Pacific Coast practice, due to the fact that a portion of the steam generated by burning fuel oil is utilized in atomizing the oil itself. some are prone to penalize the evaporating power of the boiler by deducting the heat equivalent of the steam as used.

As generally understood the "efficiency of boiler, furnace and grate" is the relation between the heat absorbed per pound of fuel fired, and the calorific or heating value of this pound of fuel. The "efficiency of boiler and furnace," on the other hand, is the relation between the heat absorbed per pound of combustible burned, and the calorific value of one pound of combustible. This latter expression of efficiency furnishes a means for comparing one boiler and furnace with another where the losses of unburned fuel due to grates and cleanings are eliminated.

We are told in the revised rules of the American Society of Mechanical Engineers for boiler testing that the "combustible burned" is determined by suptracting from the weight of coal supplied to the boiler, the moisture in the coal, the weight of ash, and the unburned coal withdrawn from the furnace and ashpit, and the weight of dust, soot, and refuse, if any, withdrawn from the tubes, flues and cumbustion chambers, including ash carried away in the gases, if any, determined from the analysis of coal and ash. The "combustible" thus used for determining the calorific value is the weight of coal, less the moisture and ash found by analysis.

As no specific rules are laid down by the national society for fuel oil burning, confusion has thus arisen. A strict interpretation of the efficiency of boiler and furnace would thus make it imperative that the heat equivalent of steam used in atomization be deducted. For many cases of comparison, however, such deduction is unjust because boilers operating with different burners, for instance, may require varying amounts of steam in atomization due to no fault in boiler design. Since such clouding of boiler efficiencies exists, the standards committee of the American Society of Mechanical Engineers would do well to be more specific, particularly for boiler tests using fuel oil.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

V. C. Gilpin, sales manager for the Braiduct Company, is at San Francisco.

John M. Klein of Mathias Klein & Sons of Chicago is at San Francisco.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Co., is at Seattle.

F. G. Baum, chief engineer with the Pacific Gas & Electric Company is making a brief trip East.

W. P. Sherman, engineer with the Platt Iron Works, is at San Francisco, making his headquarters with Chas. C. Moore & Company.

M. C. Lord, electrical engineer, Seattle, has the job of installing the electrical equipment for the Terminal Lumber and Shingle Company at Vancouver, B. C.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Co., has returned to the Eastern factory via Portland, after about a month's visit to the Pacific Coast.

R. W. Clark, formerly with the Minneapolis General Electric Company, has been made assistant manager of the Puget Sound Traction, Light and Power Company at Seattle.

F. H. Shepard, special representative of the Westinghouse Electric and Manufacturing Company, New York, spent several days during the week of March 9th in Seattle on general work of the company.

Arthur S. Merrill, sales representative of the Chicago Fuse Manufacturing Company, is visiting the Pacific Coast trade. He left California this week for Portland and Seattle.

C. V. Schneider of the Electric Supply Company at Sacramento, Cal., was at San Francisco during the past week and reported great enthusiasm for the Jovian Rejuvenation at Sacramento on March 29th.

J. C. Nowell, formerly plant manager of the Bell Telephone Company of Pennsylvania at Philadelphia, has been chosen general manager of the Pacific Telephone and Telegraph Company at San Francisco.

Frank H. Gale, manager of the advertising department of the General Electric Co., is at San Francisco, where he addressed the Electrical Development and Jovian League and the San Francisco Ad Club during the past week.

Albert Harris of the Harris Trust and Savings Bank, Chicago, and **A. B. Forbes** of Harris, Forbes & Co. of New York, heavy investors in electrical securities, have been in Seattle and other Northwest cities for some time sizing up conditions and looking over plants.

A. J. Kennedy, formerly manager of the incandescent lamp department of the Westinghouse Electric and Manufacturing Company's Los Angeles district office, has entered the firm of B. F. Kierulff Jr. & Co. as sales manager of the electrical equipment department.

C. E. White has joined the Pacific Coast sales organization of the Holophane Works and will devote most of his time to the Pacific Northwest. He is now giving a series of lectures before the members of the Electric Bond & Share Company's properties in Utah.

E. A. West, assistant engineer for the Portland Railway, Light and Power Company, has been elected chairman of the Portland branch of the National Electric Light Association, **R. S. Carroll**, assistant engineer line department of the Portland Railway, Light and Power Company, treasurer, and **C. B. Smith**, assistant engineer of the Pacific Power and Light Company, secretary.

M. H. Gerry Jr., president of the International Power and Manufacturing Company of Helena, Mont., **Robert Howes**, consulting engineer at Seattle, Wash., **James A. Lighthipe**, electrical engineer with the Southern California Edison Company at Los Angeles, Cal., **C. E. Magnusson**, professor of electrical engineering at the University of Washington, Seattle, Wash., **Wynn Meredith**, member of firm of Sanderson & Porter, San Francisco, Cal., and **Wm. S. Turner**, consulting engineer at Portland, Ore., have been transferred to the grade of fellow in the American Institute of Electrical Engineers.

Geo. J. Henry Jr., consulting engineer at San Francisco, has been appointed district sales agent for the Wm. B. Pollack Company of Youngstown, Ohio, for California, Oregon, New Mexico and Arizona, long established as one of the best and largest manufacturers in the United States of heavy steel constructions, including pipe lines for all purposes. Mr. Henry also represents the Mannesmannrohren works of Germany, and is supplying the high pressure pipes for the 60,000 kw. installation of the Pacific Light and Power Company, Los Angeles, at their Big Creek plants. This pipe is now being delivered at the power site.

Theodore N. Vail has been elected life member of the corporation of the Massachusetts Institute of Technology together with **William Endicott Jr.** and **Everett Morss,** of Boston. Mr. Vail is president of the American Telephone & Telegraph Company, which through him has just made the gift of $25,000 to maintain the electrical library given to Tech. in the summer. Mr. Endicott is a Boston banker, member of the firm of Kidder, Peabody & Company. His father is one of the life members, so that both will now be together in the councils. Mr. Morss is a well known business man who has been active in alumni work, and is president of the Simplex Electrical Company.

R. B. Barnard. salesman Westinghouse Electric and Manufacturing Company, at Butte, Mont., **L. H. Beebe**, salesman General Electric Company, Los Angeles, Cal., **C. E. Cleveland,** instructor in electrical department, Portland School of Trades, Portland, Ore., **J. P. Hart**, draftsman Portland, Eugene and Eastern Railway, Portland, Ore., **George S. Humphrey,** distribution engineer Utah Power and Light Company, Salt Lake City, Utah, **James A. Shepard,** electrical engineer Tucson Gas, Electric Light and Power Company, Tucson, Ariz., **S. E. H. Smith**, district manager Sunbeam Incandescent Lamp Company, Vancouver, B. C., **Herbert Speight**, electrician Granby Mines, Anyox, B. C.; **B. R. Trout**, switchboard operator, Great Falls Power Company, Great Falls, Mont., **H. L. Twaddle**, Second Lieutenant, Fort Wright, Spokane, Wash., **D. I. Walker**, chief operating engineer, Vancouver Island Power Company, Victoria, B. C., and **J. F. Wheelock**, operator Colgate Power House, Pacific Gas and Electric Company, Dobins, Cal., have been elected associates of the A. I. E. E.

L. J. Corbett, associate professor of electrical engineering at University of Idaho, Moscow, Idaho, **J. G. Deremer**, chief engineer United Light and Power Company, San Francisco, Cal., **W. K. Fruedenberger**, chief engineer Public Service and Railroad Commissions of Nevada, Carson City, Nev., **James M. Gaylord**, engineer United States Reclamation Service, Los Angeles, Cal., **F. W. Harris**, consulting engineer, Los Angeles, Cal., **John Coffee Hays**, president and consulting engineer Mt. Whitney Power and Electric Company, Visalia, Cal., **W. A. Hillebrand**, professor of electrical engineering Oregon Agricultural College, Corvallis, Ore., **Paul Lebenbaum**, electrical engineer Portland, Eugene and Eastern Railway Company, Portland, Ore., **Edgar A. Loew**, assistant professor of electrical engineering, University of Washington, Seattle, Wash., **T. L. Philips**, construction engineer Pacific Light and Power Corporation, Los Angeles, Cal., **I. A. Rosok**, chief electrician Bisbee Improvement Company, Bisbee, Arizona, and **Herbert S. Sands**, manager industrial and power division of Westinghouse Elec. & Mfg. Co., Denver, have been transferred to the grade of member in the American Institute of Electrical Engineers.

MEETING NOTICES.

Oregon Technical Club

The regular meeting of the Oregon Technical Club was held at the Portland Commercial Club, Tuesday noon, March 11th. Geo. Sailor of the N. E. L. A. was chairman. The speakers were Paul Lebenbaum, chief electrical engineer of the P. E. & E. Railway and K. A. Schaller of the railway department of the Westinghouse Electric & Manufacturing Company.

Mr. Lebenbaum gave a general talk on his company's electrification, stating that there would ultimately be 262 miles of road electrified, the trolley voltage being 1500 volts d.c. They buy power from the P. R., L. & P. Co. at 60,000 volts, three-phase, 60 cycle, and use transformers and motor-generator sets to obtain the 1500 volts d.c. On the first section between Portland and Eugene they will have six sub-stations, approximately 22 miles between them. Mr. Schaller gave a general talk on the electrification of old and new railroads, describing briefly the various standard practices.

The "Home Warming" of the Oregon Technical Club was postponed from February 22d until March 8th. About 70 members enjoyed an informal meeting in their new quarters at 247½ Stark street. Good fellowship and sociability prevailed throughout the evening, which was devoted to smoking, story telling, impromptu speeches, followed by a Dutch lunch.

Tacoma Jovian Luncheon League.

The Tacoma Jovian Luncheon League at its luncheon given on March 5th, was addressed by Mr. Osborn of the Washington Water Power Company, Spokane. The subject up for consideration was proposed legislation before the Washington legislature to settle the question as to who shall pay for cluster lighting systems. Mr. Osborn took the ground that the city after constructing these systems should be allowed to charge the cost back to the property owners along the street, the city then maintaining the system. A. L. Thorn, superintendent of city lighting, also made a few remarks, taking a similar stand.

Seattle Jovian League.

The Seattle Jovian League was provided with a special salmon dinner by the management of the Rathskeller at its regular weekly luncheon on March 14th. The meeting was addressed by Captain Thomas Davies, port warden, on the volume of business coming in and going out over the wharves and piers of Seattle. Remarks were also made by G. F. Fay, manager of the Drummond Literage Company, who spoke on the recent enlargement of the Seattle Port Commission from three to five members by the legislature. He urged the co-operation of the Jovians in the election of the two additional members.

Seattle Section, A. I. E. E.

The March meeting of the Seattle Section of the American Institute of Electrical Engineers was held March 18th in the Good Roads building, on the University Campus, under the auspices of the Electrophysics Group. Prof. E. A. Loew read a paper on "The Oscillograph and Oscillograms," and a stereopticon exhibit of some recent osciligrams taken in the laboratory was given by L. E. Curtis. The meeting then adjourned to the engineering laboratory for the inspection of the University oscillograph equipment and other apparatus and laboratories used for electrical testing and research work.

Electrical Development and Jovian League.

This week's meeting was immensely interesting, the entire session being devoted to an illustrated lecture, "The West as World-Beaters in Engineering, by Prof. Robert Sibley, of the Mechanical Engineering Department of the University of California, and editor of the Journal of Electricity. Among the subjects touched upon were several of the great government irrigation projects, Los Angeles' water supply system, Hetch Hetchy water supply, San Francisco's high-pressure fire protective system, and several of the great hydroelectric power projects, among them the Lake Spaulding plant of the Pacific Gas and Electric Co, and the Big Meadows project of the Great Western Power Company. Over seventy members attended the luncheon and listened with pleasure and interest to the address.

Portland Jovian Luncheon Club.

The Jovian Luncheon Club met for the second time in the Oregon Grill, on Thursday, March 13th. The chair was filled by C. P. Osborne, superintendent of power of the P. R., L. & P. Co. Before the speaker of the day delivered his address, Mr. Osborne called upon various members to answer the following questions:

What is a vacuum and how can you obtain one? A. S. Moody.

What is the difference between kw. and kw.h.? J. C. Hinkle.

What is meant by load factor? W. H. Lines.

What is meant by C^2R activity? E. D. Le Tourneau.

What is meant by wattless current? H. R. Wakeman.

What is meant by diversity factor? R. R. Rabley.

What is the purpose of a fuel economizer? G. Jett.

What is mean by the elastic limit of wire in a cable? E. D. Searing.

A motion was made and carried that the affairs of the Jovian Luncheon Club, in the future, should be in the hands of an executive committee of three members. The chairman or oldest member of the executive committee to be the member who becomes automatically the chairman. The chairman to hold office for a month. A new member to the executive committee to be elected each month by the club. This first executive committee elected was F. D. Weber, chairman; G. M. Baker, A. C. McMicken.

Marshall Dana, associate editor of "The Oregon Journal," then spoke on "Commission Government." Mr. Dana said in part: "Government must be under the eye of the public to be efficient.' Destructive criticism is generally backed by gross ignorance. The only criticism that produces any good is constructive criticism and can only be made after deep study and by the careful investigation. Do not criticize public officials for their acts, but criticize yourself for allowing a system which makes it possible to allow a public official to be held up to public criticism. Commission government gives the people the opportunity to study their government as public officials have their actions constantly under 'the check' of the public. Portland needs 'organized co-operative selfishness' to attain 'civic perfection,' not 'disorganized selfishness.'"

The stunt for next week's luncheon will be a debate. The question to be debated is "Should Jovianism Uphold Woman's Suffrage?"

NEW CATALOGUES.

Bulletin No. 19 from the Century Electric Company illustrates and describes Invincible Split Phase Constant Speed Motors in a most attractive manner.

Pierson, Roeding & Company have issued a neat booklet containing valuable data on Western Washington Cedar Poles, Douglas Fir, Cross Arms and Eucalyptus Pins and Brackets, as well as other transmission material which they are prepared to furnish.

G. A. Wilbur, San Francisco representative of the Duncan Electric Manufacturing Company is distributing Bulletin No. 26 on Duncan Portable Test Watthour Meters for checking the accuracy of consumers' meters. These meters are manufactured in several types for either a.c. or d.c. use.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

STANDARD SPECIFICATIONS FOR WIRING BUILDINGS.

(Concluded.)

Example No. 7—For Concealed Knob and Tube Work in a flat building in the Overhead District having individual meters for the various tenants, and overhead service. (Where underground service is desired and a common basement or back porch is available for the location of a common meter board, the specifications for "Service," "Meter Board" and "Meters" as given in "Example No. 6," for apartment buildings, will apply to flat buildings).

Service:

Separate service outlets for each flat are to be run from each meter to and through the .... side of the building, and sufficient wire left extended to provide easy connection of service drops.

Main Service Switches and Cutouts:

(87) A main service switch and enclosed fuse cutout of the proper size is to be furnished and installed on each of the above mentioned services at points shown on plans, same to be enclosed in wooden cabinets located within easy reach from the floor, thoroughly lined with asbestos and painted to comply with all rules and requirements. The doors of same are to be fitted with suitable spring latches and hinged at the top so as to be self-closing.

Meters:

(88) Standard General Electric Company's recording wattmeters arranged for side connection will be furnished and installed by the P. R. L. & P. Company for each of the above mentioned services. The contractor, however, is to do all the neecssary wiring about the meters and provide ample wire for connection to the meters. The meters are to be located at points shown on plans.

Lighting Feeders:

(89) From the meters 3-wire feeders are to be run direct to the branch cutout cabinets in each of the flats having more than 12-16 c.p. lamps or their equivalent.

(90) In those flats having 12-16 c.p. lamps or less, a 2-wire feeder is to be run direct from the meter to the lamp or switch outlets in such flats.

Cutout Cabinets:

Copy clauses (82) omitting reference to janitor's apartment. Copy clause (71).

Branch Circuits:

Copy clauses (48) and (49).

Switches:

Copy clause (55).

(91) The lamps in the entry and at the head of the stairs of the upper flats are to be controlled by a set of 3-way switches, one switch to be located at the foot of the stairs and the other at the head of the stairs.

(92) The porch lamps of the lower flats are to be controlled by flush push button switches located in the halls just inside the outer front door. The switches controlling porch lamps of the upper flats are to be located in the upper halls at the head of the stairs.

(93) The rear porch and the basement lamps are to be controlled by rotary switches located in the kitchen, as shown on plans.

(94) Lamps in the attic halls are to be controlled by a set of 3-way switches, one of these switches to be located at the foot of the stairs and the other at the head of the stairs.

Example No. 8—For Conduit Work in a Warehouse or Factory Building in the Overhead District, having underground service down pole.

Service: Copy clauses (72) to (76) inclusive.

Meters:

(95) Standard General Electric Company's recording wattmeters arranged for side connection, will be furnished and installed by the P. R. L. & P. Co., the wiring contractor, however, is to furnish and install at the point shown on plans, a suitable meter board and all necessary wiring on same to and from the meters.

Lighting Feeders:

(96) From the lighting meter on the meter board, a set of three (3) conductor feeders is to be run to the various branch cutout cabinets located on each of the floors at points shown on plans.

Power Feeders:

(97) From the power meter on the meter board above mentioned a feeder is to be run to the elevator motor at the foot of the elevator shaft in basement, and terminated in a switch cabinet made up of No. 12 sheet steel with doors of No. 10 sheet steel, fitted with suitable spring latches and hinged at the top so as to be self-closing. In this cabinet is to be mounted a proper switch and cutout and provision made for future connection of motor leads.

Cutout Cabinets:

(98) On each floor, from the first to the top inclusive, and at the points shown on plans, cutout cabinets are to be furnished and installed, same to be made up of No. 12 sheet steel, with doors of No. 10 sheet steel, fitted with suitable spring latches and hinged at the top so as to be self-closing. In these cabinets are to be mounted the necessary combination knife switch and plug cutout branch blocks.

Copy clause (71). Copy clauses (46) and (47).

Branch Circuits: Copy clauses (48) and (49).

Switches:

Copy clause (54).

(99) All ceiling outlets connected by curved lines to switch outlets, which are indicated thus "S" on plans, are to be controlled by rotary snap switches.

(100) A part of the lamps in the basement near the foot of the stairs are to be controlled by a rotary snap switch placed on the wall at the head of the stairs.

Example No. 9—For Concealed Knob and Tube Work or Open Work in a warehouse or factory building, in the Overhead District having overhead service.

Service:

(101) Service outlets are to be extended from the ...... side of the building at a point above the windows at the position shown on plans. From here the mains are to be run to the main service switch and cutout.

Main Service Switch and Cutout:

(102) At a point shown on plans, the wiring contractor is to furnish and install a main service switch and enclosed fuse cutout for the entire lighting system, same to be enclosed in a wooden cabinet thoroughly lined with asbestos and painted to comply with all requirements. The door of same is to be fitted with suitable spring latch and to be hinged at the top so as to be self-closing.

Copy clauses (75) and (76).

Lighting Feeders: Copy clause (96).

Meters: Copy clause (95).

Power Feeder: Copy clause (81).

Cutout Cabinets:

(103) On each floor, from the first to the top inclusive, and at the points shown on plans, wooden cutout cabinets are to be furnished and installed, same to be lined with

asbestos and painted to comply with all rules and requirements. The doors of same to be fitted with suitable spring latches and hinged at the top so as to be self-closing. The wiring contractor is to furnish and install the cabinets complete. The cabinets are to contain the necessary three-to-two wire combination knife switch and plug cutout branch blocks.

Copy clause (71). Copy clauses (46) and (47).

Branch Circuits: Copy clauses (48) and (49).

Switches: Copy clause (54). Copy clauses (99) and (100).

Example No. 10—For Concealed Knob and Tube Work in a Residence in the Overhead District, having an underground service down pole.

Service:

Copy clauses (72) and (74).

(104) From the main service switch the wiring contractor is to extend the service mains to the meter board located at point shown on plans.

Meter:

(105) A Standard General Electric Company's recording wattmeter arranged for side connection will be furnished and installed by the P. R. L. & P. Co., the wiring contractor, however, is to furnish and install at point shown on plans, a suitable meter board and all necessary wiring on same to and from the meter.

(106) From the meter the mains are to be run to the branch cutout cabinet at point shown on plans.

Cutout Cabinet:

(107) On the second floor, at point shown on plans, a wooden cutout cabinet is to be furnished and installed, same to be lined with asbestos and painted to comply with all rules and requirements. The door of same to be fitted with a suitable spring latch and hinged at the top so as to self-closing. The wiring contractor is to furnish and install the cabinet complete. The cabinet is to contain the necessary three-to-two wire plug cutout branch blocks.

Copy clause (71).

Branch Circuits: Copy clauses (48) and (49).

Switches:

(108) The lamp in the vestibule is to be controlled by one set of 3-way switches, one of these switches to be located on the outside of the front entrance and the other inside of the inner vestibule door, at the point shown on plans.

(109) The porch lamp is to be controlled in the same manner with switches located beside those of the above mentioned set.

(110) The lamp in the hall on the first floor is to be controlled by a set of 3-way switches, one to be located at the foot of the stairs and the other at the head of the stairs, at the point shown on plans.

(111) The lamp in the upper front hall is to be controlled in the same manner, with switches located beside those of the above mentioned set.

(112) The lamp on the back stairway is to be controlled by one set of 3-way switches, one to be located in the kitchen to the left of the entrance to the back stairway, and the other to be located at the head of the stairs at point shown on plans.

(113) All ceiling outlets are to be controlled by flush push button switches (face plates to match other hardware) with the exception of those in closets and pantries, which are to be controlled by rotary snap switches.

(114) The lamp at the foot of the basement stairs is to be controlled by a rotary snap switch placed at the head of the stairs.

Note:—Owing to the increasing use of electrically operated heating, cooking, cooling, and power appliances in the household, it is advisable in wiring first-class houses to provide connection for at least a few of the above mentioned articles. The P. R., L. & P. Co., will be glad to offer suggestions as to the best means of providing such connections upon request.

Example No. 11—For Concealed Knob and Tube Work in a Residence in the Overhead District, having an overhead service.

Service: Copy clause (101).

Main Service Switch and Cutout:

Copy clause (102). Copy clause (104).

Meter: Copy clauses (105) and (106).

Cutout Cabinet: Copy clause (107). Copy clause (71).

Branch Circuits: Copy clauses (48) and (49).

Switches: Copy clauses (108) to (114) inclusive.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

March 10.

J. H. Evans, who conducts a telephone exchange at Patterson, Stanislaus county, filed an application asking that his company and the Pacific Telephone & Telegraph Company be permitted to enter into an agreement for an interchange of telephone and telegraph business. The Pacific Telephone & Telegraph Company joined in the application.

The San Diego & Southeastern Railway Company applied for authority to issue $500,000 of bonds, the proceeds of which will be used to discharge existing indebtedness.

March 11.

A decision was rendered granting authority to the San Diego Consolidated Gas & Electric Company to issue $106,000 of 6 per cent debentures. The original application was for $500,000. The proceeds will be used to discharge indebtedness.

The Livermore Water & Power Company and W. A. Bissell applied for authority to sell their plant to the Pacific Gas & Electric Company for $142,000. The latter company asked for authority to issue 1400 shares of its common stock at 65, in part payment.

The Tulare County Power Company applied for authority to issue $50,000 of stock and use the proceeds in extending its line.

March 12.

The Petaluma Power & Water Company filed its answer to the complaint of the city of Petaluma, asking for specifications and particulars in which it failed to provide adequate service.

A decision was rendered granting the application of E. W. Crosby to sell and of the Reedley Telephone Company to purchase the Reedley telephone exchange plant. The Reedley Telephone Company was also granted authority to issue $11,000 of stock.

A decision was rendered granting the application of the Great Western Power Company for authority to issue $4,411,000 of bonds. The proceeds will be devoted to general improvement, extension and development of the company's facilities, including the Big Meadows dam and reservoir, which will be completed at a cost of approximately $1,607,635.

March 13.

A. A. Weber filed an amended application for a certificate of public convenience and necessity to operate a gas plant in Dinuba.

A decision was rendered granting authority to the Southern Sierras Power Company to purchase the Elsinore Electric Light & Power Company at Elsinore, for $7500.

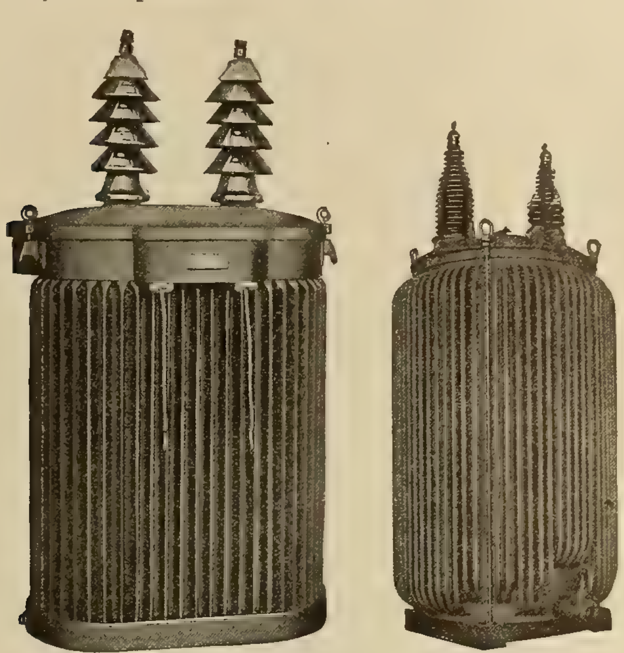
March 14.

A decision was rendered reducing the gas rate in the city of Palo Alto from $1.50 per thousand to $1.20 per thousand feet. The Commission found that under the rate of $1.20 per thousand feet, the Palo Alto Gas Company would have a return in excess of 8 per cent on its investment.

INDUSTRIAL

HIGH TENSION OUTDOOR TRANSFORMERS.

Recently high-tension transformers of all capacities and for any commercial voltage have been designed by the General Electric Company for outdoor service to meet the demand for power by consumers along high-tension transmission lines, who realize the advantages of electricity for both power and light, but who do not require enough power to justify the expense of a substation.



High Tension Outdoor Transformers.

Power transformers, 100 to 500 k.v.a., for distributing potentials (2300-6000) and all transformers above 6000 volts up to 500 k.v.a., employ the straight two-legged core type construction. The core consists of two vertical legs connected together at the top and bottom by yokes, thus forming a rectangle. Cylindrical coils and insulation cylinders are placed concentrically over the two vertical legs of the core, the high-voltage winding being outside the low-voltage winding and separated therefrom by oil ducts and the above-mentioned insulating cylinders.

Power transformers for all voltages may be self-cooled or water-cooled. In self-cooled transformers, the heat arising from the losses in the transformer is dissipated into the surrounding air by providing a tank with sufficient external radiating surface to limit the temperature inside the transformer to a safe value. The tanks for these transformers are made from sheets of steel, corrugated under great pressure and electrically welded together. A base and rim are cast directly to the corrugation, the joint between them being an actual weld. This forms a rigid one-piece tank which, when supplied with a suitable cover and gasket, is readily adapted for outdoor operation.

The main difficulty, however, in designing high-voltage transformers for outdoor use is encountered in bringing the leads out of the tank. In transformers below 17,500 volts this is easily accomplished by bringing them out through porcelain bushings set in, or underneath, the rim around the top of the tank. For potentials above 17,500 volts this method is unsafe so the leads are brought straight out through openings in the cover and protected from the weather by a porcelain covering, built up of several petticoats.

In water-cooled transformers, the heat generated by the losses in the transformer is artificially extracted from the oil by circulating cold water through a seamless coil of pipe placed in the upper part of the tank and submerged in the oil. The expensive corrugated tanks for radiating the heat are, therefore, unnecessary, so a plain steel plate tank is provided. Transformers in these tanks are suitable for outdoor operation when equipped with porcelain petticoat leads brought out through metal bushing holders.

Transformers having a capacity greater than 500 k.v.a. are built of the shell type, i.e., the core surrounds the windings, which is in direct contrast to the core type, where the windings surround the core.

Self-cooled, small type transformers are not built in capacities much above 3000 k.v.a. because of the large and expensive tank construction necessary to obtain sufficient radiating surface. The extra radiating surface necessary for self - cooled transformers above 750 k.v.a. is obtained by compounding the corrugation; i. e., two plain corrugated sheets are welded together to form one large corrugation. This tank has about 65 per cent more radiating surface than the plain corrugated tank. Another type of tank for large capacity self-cooled transformers is known as the "tubular" or "pipe" tank. This consists of a boiler plate tank having the ends of a double row of vertical steel tubes welded into it at the top and bottom, this providing a natural circulation for the hot oil from the top to the bottom of the tank through these external pipes, where the heat is quickly dissipated. The majority of transformers above 1000 or 1500 k.v.a. are water-cooled.

The tanks for water-cooled transformers are made from heavy boiler plate, being round for single-phase transformers and elliptical for three-phase units. They are perfectly plain and smooth, having no corrugation or pipes, which are unnecessary in this type of transformer. All these various tanks are designed for outdoor use when furnished with a suitable cover, gasket and loads.

Three large water-cooled transformers, 2750 k.v.a. each, have recently been designed for outdoor operation on a 110,000 volt circuit. These are in successful operation at the present time. Some 1000 k.v.a. self-cooled transformers in tubular tanks are also in successful operation outdoors on a 110,000 volt circuit.

TRADE NOTES.

The Denio Fire Alarm Company have just signed a contract with the Portland Railway, Light and Power Company for the equipment of three buildings of their new car shops.

The Westinghouse Electric and Manufacturing Company has received an order from the Puget Sound Traction Light and Power Company for a 1000 k.v.a. water-cooled transformer for the Tacoma smelter sub-station and for two 1000 k.v.a. air-blast transformers for the same company to be used in Seattle.

The Kilbourne & Clark Manufacturing Company, at 307 First Avenue South, Seattle, has under way the construction of an up-to-date plant at Columbia street and Western avenue. A recent fire put the company out of commission for a time and in going over the situation it was thought best to seek a new location. More room was needed for a growing business, enough business being on hand at this time to run the plant for six months. The chief feature of the industry is the building of rotary converters for wireless telegraph work. Over ninety per cent of the ships outfitted on the Pacific Coast have been supplied from the Kilbourne & Clark works.

NEWS NOTES

NEW INCORPORATION.

PRINEVILLE, ORE.—The Deschutes Power Company has been incorporated as a combination of the Cove Power Company at Culver, Oregon, and the Prineville Light & Power Company of Prineville, Ore. The two towns have already been connected by a 50 mile transmission line.

ILLUMINATION.

CASHMERE, WASH.—The council passed a resolution for the installation of a lighting system.

PORT TOWNSEND, WASH.—The mayor vetoed the franchise of the Key City Light & Power Company.

NEWPORT, ORE.—The Yaquina Electric Company will enlarge its plant at Newport and install new machinery to the extent of $3500.

QUINCY, WASH.—An ordinance was introduced for a franchise for the Wenatchee Valley Gas & Electric Company for electric light and gas.

WENATCHEE, WASH.—Wilbur B. Foshay, Portland, has applied for a franchise for an electric power plant and for a central steam heating plant.

HUNTINGTON, BEACH, CAL.—Bids will be received up to April 7th for furnishing municipal lights and municipal lighting for the city of Huntington Beach.

ALHAMBRA, CAL.—The board of trustees has awarded the contract for the improvement of Main, Garfield and Fair Oaks avenues to the Newberry-Bendheim Electric Company, for $20,456, with lighting system complete.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will furnish light in Pleasant Valley and Jenne station on the Gresham Electric Railway, if the improvement club will secure enough subscribers.

BAKERSFIELD, CAL.—The board of supervisors has authorized an advertisement for bids for the erection of an electric light system for the Randsburg public highway lighting district, the bids to be received up to April 10th.

NEW WESTMINSTER, B. C.—The council has decided to proceed at once with the establishment of a municipal gas plant. H. Pabst of Portland is the engineer engaged to prepare plans and specifications and to call for bids and supervise the installation. The estimate of cost is placed in the neighborhood of $20,000.

NEWPORT BEACH, CAL.—The city trustees have employed Engineer J. I. Seamans to make an appraisement of the local light plant, bonds for the purchase of which were voted last September. If the appraisal is satisfactory to the owner of the local plant, the city will purchase the same, otherwise the city will build a distributing system out of the general fund and buy its current from one of the big power companies.

OAKLAND, CAL.—Electric and gas rates for the present year will remain the same as the rates of 1912 under the ordinance passed by the city council last week. The rates for the first 10,000 cubic feet of gas will be 90c per 1000; from 10,000 to 20,000, 85c; from 20,000 to 50,000, 80c, and more than 50,000 cubic feet, 75c per 1000. The electric light rates are 7c a kw.-hr. for the first 100 kw.-hrs.; 100 to 250 kw.-hrs., 5c; 200 to 300 kw.-hrs., 4c, and more than 400 kw.-hrs., 3c.

GALLUP, N. M.—The new building of the Gallup Electric Light Company is under way, and in course of a few weeks will be ready to receive the new machinery which the company is installing. Mr. B. R. Ellis, who has recently become interested in the company, was in town completing arrangements for the installation of the machinery, and will return soon to make arrangements for extensive improvements to poles and lines for power purposes. Within 60 days it is expected that current will be available for power purposes.

TRANSMISSION.

REDLANDS, CAL.—Work will commence in April on the construction of the power plant which C. G. Baldwin commenced last year in Mill Creek canyon. The estimated cost is $500,000.

VISALIA, CAL.—The Tulare County Power Company is making arrangements for the increasing of the capacity of the plant at Tulare and for the erection of many additional miles of pole lines through the southern end of the county.

NELSON, B. C.—The Wanoto Development Company will expend $75,000 on construction of a power plant at the junction of the Salmon and Pend d' Oreille rivers, according to David Walmsley of Nelson, one of the directors of the company. Work will commence shortly on the plant, which will have an initial capacity of 2500 horsepower. It is planned to build a line to Sheep Creek to supply the mines of that camp. American capital is behind the project.

SPOKANE, WASH.—A prospectus for a $1,400,000 power plant to be erected at the Weeks power site on the Spokane River at Trent, has been laid before the commissioner of public utilities, C. H. Fassett, by George B. Dresher, who submits a general outline based on a survey and estimate of cost made by Daniel Mead, professor of electrical engineering at the University of Washington. It is the intention to get a movement for a municipal power plant started in Spokane.

ARTESIA, TEX.—The power plant of the Pecos Valley Gas & Electric Company has begun operations. This plant was built or the purpose of furnishing power for irrigation purposes in the desert land lying outside the artesian belt. Twenty miles of country lines are now in operation, to be utilized for pumping water for irrigation. During this summer an additional unit of equal size will be put in and lines are to be run to Yayton and Lakewood into the pumping districts adjacent to these places.

DOWNIEVILLE, CAI.—The Sierra Power Company has applied for a franchise to erect and maintain electric power lines in this county. The same company has made similar applications in Plumas, Butte, Shasta, Glenn, Tehama, Colusa, Yolo, Solano, Yuba, Sutter and other counties of Superior California. It is trying to finance its project and these franchises would give it something on which to work. Albert C. Agnew is the representative who made application for the franchises. The franchise is to be offered for sale to the highest bidder here on April 7th.

AUBURN, CAL.—Many carloads of steel material for towers for a power line are now being hauled from the Nevada street freight house to Nevada county at a point about eight miles above the Bear River bridge on the Auburn-Grass Valley road. The towers will be used to carry wire of a high tension power line which will extend down through Nevada county to the McCourtney crossing of Bear River, and thence westward across the plains, crossing the Sacramento River near Vernon, continuing down through the Sacramento Valley to some point on San Francisco Bay. The Pacific Gas & Electric Company is doing the work and will transfer the electric current for power from a powerhouse situated below Grass Valley, where the waste water from the mines will be used to generate the power and then sold to farmers lower down for irrigating purposes.

TRANSPORTATION.

BURLINGAME, CAL.—The Burlingame Railroad Company, which built and operates the new Easton car line, has applied for a franchise for an extension to the Burlingame station.

AUSTIN, TEX.—A. V. Cole of Brownsville, Texas, has been granted a concession by the government of the state of Tamaulipas, Mex., for the construction of an extensive system of electric street railway, in Matamoras as well as extension of lines to other towns in that section. Negotiations are pending for the transfer of the concession by Mr. Cole to a syndicate of St. Louis men.

SACRAMENTO, CAL.—Attorneys for the Pacific Gas & Electric Company have filed application with the city commission for permission to open up Third street and certain parts of I and J streets, so that heavier steel rails may be laid. The Oakland, Antioch & Eastern Railway will use the tracks of the Pacific Gas & Electric in this district and it is desired to lay rails, not only heavier than those now in use, but lay the tracks a greater distance apart. The matter was referred to Commissioner Wilder of the department of public works.

STOCKTON, CAL.—Superintendent J. J. Hooper of the Stockton Electric Railroad announces that work on the North Ophir street car line, which will connect with the main street line, will be started next month. "I have received the shipping receipts for the curves. The ties will come from Santa Cruz and the poles will come from this State also. We could have started on the overhead system before this if the poles had been on hand. I am now listing the wooden poles on Main street which are to be removed. Some time ago we adopted a policy of displacing the wooden poles with steel poles. We did this wherever possible through the business section."

SAN FRANCISCO, CAL.—Construction of the extension of the Geary street municipal railway down Market street probably will be postponed until after the referendum election April 22. A second conference was held in Mayor Rolph's office between the municipal authorities and representatives of the United Railroads, in which the latter made it plain that if the city attempted to begin work before the election the company would be compelled to secure an injunction. While no formal decision was reached by the city officials, they took the position that it might be well to wait until after the election in order to keep the matter out of the courts. The stand taken by the United Railroads is that the city has no right at present to construct the two blocks of track from Kearny to Sansome streets, in Market street, for the purpose of running the Geary street cars to the ferry. It is contended the company's franchise rights would be jeopardized if the city were permitted to lay the rails at this time. If the people vote in favor of the traffic agreement its terms will automatically go into effect, thus permitting joint use of the outer tracks in lower Market street by the Sutter street cars and those of the municipal railway, as well as exchange of transfers and the other important privileges embodied in the compromise.

TELEPHONE & TELGRAPH.

CENTRALIA, WASH.—The Pleasant View Telephone Company have petitioned for telephone franchise in east Lewis county.

KOSMOS, WASH.—The board of county commissioners granted a franchise to J. P. Bucher for a line from Kosmos to Morton.

CLARKSTON, WASH.—The Pacific Telephone & Telegraph Company will have surveyors at work at once for construction of the line between here and Asotin.

NEWPORT, WASH.—A committee of Deer Valley farmers petitioned the county commissioners for the right to construct a telephone line along the highway connecting with Newport.

ALAMEDA, CAL.—Sealed bids will be received by the Board of Electricity of Alameda, up to March 27th, for furnishing and installing a police telephone and flash light system for the city.

RIVERSIDE, CAL.—The Pacific States Telephone & Telegraph Company have applied to the city council for a franchise to operate in Riverside. The council will take the matter under advisement for a month, while the Pacific people negotiate for the purchase of the Home system.

SOUTH PASADENA, CAL.—Representatives of Pasadena Home Telephone Company have applied for a franchise to lay conduits for their telephone wires from bridge across Arroyo at the west city limits, along Pasadena avenue, Mission street and Fair Oaks avenue, to the north city limits of Columbia street, the conduits to be laid in parkways, and not in streets, most of which have been recently paved.

ALAMOGORDO, N. M.—A proposition is under consideration for the projected telephone line from Cloudcroft to Mathill. The line will be 20 miles long, and run down James canyon and connect the farms and ranches along the line. Negotiations are being made with the Mountain States Telephone & Telegraph Company to connect at Cloudcroft with long distance line. It is expected that organization, which is being formed for the purpose of financing the line, will be completed soon and arrangements made to begin work at once.

OAKLAND, CAL.—The city of Oakland has begun suit to forfeit the bond of the Bay Cities Home Telephone Company. The bond totals $100,000 and the bondsmen are J. S. Torrance, Thos. W. Phillips, Wm. Thomas, Mark L. Gerstle and P. E. C. Bowles. The action is based on the contention that the telephone company violated its franchise when it merged with the Pacific Telephone & Telegraph Company last March. The Home company operated under a franchise granted by the city council on January 15, 1906, and City Attorney Woolner maintains that the provisions of the franchise specifically provide for the forfeiture of the bond in the event the company merged with another.

WATERWORKS.

OLYMPIA, WASH.—Wilbur B. Foshay of Portland has applied for a franchise for an electric steam heating and water plants in Olympia.

SACRAMENTO, CAL.—City Engineer Givan is working on the plans and estimates called for by the city commission of the contemplated water mains extension for the annexed territory.

BRAWLEY, CAL.—No. 8 District Water Company has sold 13,000 shares of No. 8 stock and proceeds from 2000 shares, amounting to $20,000, are being used for improvement of the system.

MAYFIELD, CAL.—Sealed bids will be received up to April 7, for the laying of water mains together with necessary valves and fittings and the installation of fire hydrants with connecting pipes and fittings in the town.

SANTA MARIA, CAL.—The Santa Maria Water Works is now fully under control of the Domestic Water Company, and Engineers Haviland & Tibbetts have charge of the entire plant. It is proposed to improve the plant up to the full standard of the requirements of the city.

PERRIS, CAL.—This town will have a domestic water system in the near future. Frank A. Lathrop will be in charge of the work. He has designed a system, whereby town will have ample supply of water for domestic purposes. Wells will be put down and in all probability water will be distributed to consumers by gravity.

ALPHABETICAL INDEX TO ADVERTISERS

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Manhattan Elec. Supply Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.
Manhattan Elec. Supply Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Manhattan Elec. Supply Co.
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
Geo.E.DowPumpingEngineCo.
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All Jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Dow Pump'g Engine Co.,Geo.E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.

Economy Electric Co.
San Francisco, 444 Market

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 726 Mission
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-**Reynolds Co.**
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
Pierson, Roeding & Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Tungsten, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.
Manhattan Elec. Supply Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis Pac. Elec. Eng. Co.
Nixon Kimmel Co., A. T. Egan
Fairbanks, Morse & Co.
General Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Pittsburg Piping & Equip. Co.

Plugs, Flush
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks, Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo.
(Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Push Buttons
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 728 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Manhattan Elec. Supply Co.
San Francisco, 403 Atlas Bldg., 604 Mission St.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Nason & Co., R. N.
San Francisco, 151 Potrero Ave.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Nixon-Kimmel Co.
Spokane, 126 Lincoln St.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pac. Elec. Eng. Co.
Portland, 213 2d St.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco,MonadnockBldg

Post Co., The Frederick
San Francisco, 135 Second

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
LosAngeles, Union Trust Bldg.

Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill," Pierson, Roeding & Co.
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.
Switches, Push Button
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Tubes and Bushings
Ohio Brass Company
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee," Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
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San Francisco, 56 Natoma.
Western Electric Co.
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Western Electric Company
Western Pipe & Steel Co.
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Los Angeles, 1758 W. Broadway
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Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 Pacific Blg.
Los Angeles, Cal., Pacific Electric Bldg.
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San Francisco, 682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**

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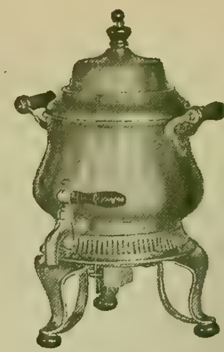

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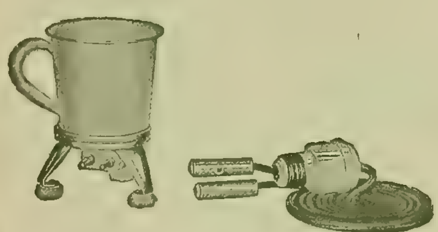

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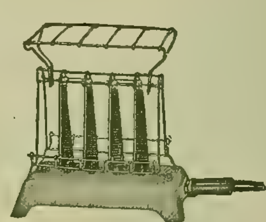

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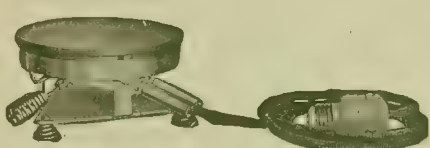

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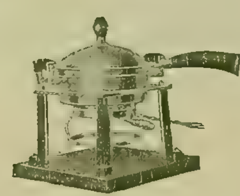

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX | SAN FRANCISCO, MARCH 22, 1913 | NUMBER 13

ELECTRIC ENERGY IN THE COEUR d'ALENES

BY JOHN B. FISKEN.

The ignition of charges of blasting powder was the first operation in mining to be accomplished with the aid of electricity. Frequently this energy was furnished by a static machine and occasionally by a magneto generator.

The Hoist of the Hecla Mine.

Later this was followed by the application of electricity to bell signals, and we are told that this application was looked upon skeptically and regarded as an expensive experiment by the mining managers of early days.

At the Paris Exhibition of 1878, there was an exhibit of an electric lamp, which suggested future possibilities to mining engineers, and the first successful application of electric lighting to underground excavations, that I have been able to find any record of is that of M. Balvier. In the year 1879 he installed two Serrin lamps and successfully illuminated one of the large underground chambers in the Angers slate quarries.

The first electric mine locomotive of which I have been able to find any record was used in Germany in 1882 in the Royal coal mine at Zaukeroda, in Saxony. This application demonstrated that electrical energy could be applied with profit in this phase of mining.

Several years elapsed, however, before any application of electrical energy to mine haulage was made in this country. About 1888 an electric locomotive, for strictly mine use, was constructed by Mr. W. M. Schlesinger of the Union Electric Coal Company in Pennsylvania.

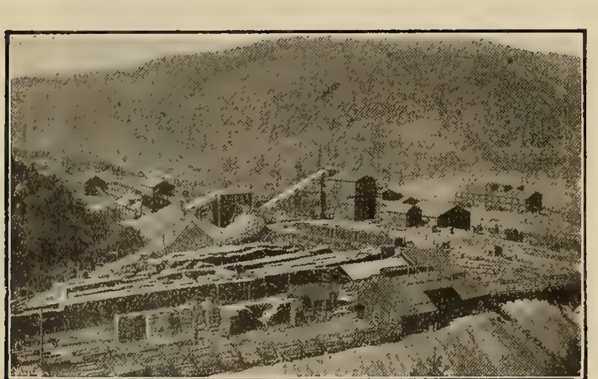
In July, 1888, the first electric hoist to be used successfully in this country, at least, if not in the world, was installed by the Aspen Mining & Smelting Company in their mine at Aspen, Colorado. In this

case the motor was a $7\frac{1}{2}$ h.p., 500 v. street railway motor built by the Sprague Electric Railway & Motor Company. It was used for hoisting on an incline, and the venture was so successful, that another similar outfit was installed in the same year.

The first general application of electrical energy to mining purposes was probably in 1888, when the electric power plant in the Comstock Lode, Virginia City, Nevada, was put in commission. It is interesting to note that in this case there were 6-120 h.p. generators, each generator being connected independently to an 80 h.p. motor, all six motors being belted to the same shaft. The generators were constant current and the motors series wound.

Early Installations iln Coeur d'Alenes.

Let us glance briefly at the history of the early applications of electricity in the Coeur d'Alene country. I believe the first installation was the one for the Last Chance Mine in 1890. This consisted of two Edison bipolar generators of 20 kw. each, operated by water power, which was used to supply a three-wire lighting system in the mine. This plant was in regular operation until 1892, when owing to the mine's indebtedness, it was shut down. The mine itself in 1893 went into the hands of a receiver, and Mr. Robert Cheyne got possession of the lighting plant. He moved it to a point near the dividing line between Wardner and Kellogg, where he operated it with water



Typical Coeur d'Alene Mining Scene.

power under 140 ft. head during high water seasons, and with steam at other times. He sold the plant to the Bunker Hill and Sullivan Company in 1897, who later dismantled it.

The next installation was at the Black Bear mine and consisted of two Edison bipolar generators of 150 kw. capacity. This plant was used for operating Marvin drills, compressor pumps and lights. I have so far been unable to find out when this plant was dismantled or what become of it.

Again we come back to the Last Chance mine in which a second Edison plant was installed with a capacity of 100 kw. This plant furnished power for Marvin drills and lights in the mine and also for lights in Page's Hotel, the Catholic Church, and a few residences. This plant, I believe, passed into the hands of the Bunker Hill and Sullivan Company.

In 1892 there was installed in the power house above Burke, a 250 h.p. Edison bipolar plant of 1200 volts d.c., and the power from this plant was transmitted to Burke where it was used for pumping purposes. This plant was in use until 1898, when the present plant was installed.

In 1896 the first installation at the Standard mine was made and consisted of a 35 kw., a.c. generator and a Thomson-Houston 45 kw., 500 volt generator for operating the mine railway. The latter machine, I believe, is in operation yet, but I do not know what has become of the former.

In 1897 the Bunker Hill and Sullivan Company moved the Last Chance plants which they had acquired to their power house adjoining the mill and in addition installed a 75 kw., 2300 volt monocyclic generator. Water power was used, under 360 ft. head, the water being flumed from Wardner. Later a Russell Tandem Compound engine was installed to help during periods of low water. This was followed in 1898 by the installation of a 55 kw., 550 volt four-pole General Electric generator driven by a hydraulic turbine operating under 46 ft. head. This plant was used during the driving of the Kellogg tunnel and later for general haulage in the mine and about the yards.

In this same year the 1200 v. d.c. plant at the Burke power house was abandoned and a 300 kw. 2300 volt, 40 cycle generator was installed. It will be of interest to note that later the Federal Mining & Smelting Company increased the speed of this machine to get a frequency of 60 cycles and now it is run in multiple with the Westinghouse Water Power Company's plant.

The next installation was made by the Bunker Hill and Sullivan Company, who in 1901, increased the capacity of their lighting plant by the addition of a single-phase 50 kw., 2300 volt generator and a Russell engine similar to the one referred to above.

Modern Electrical Operation.

No further additions were made until August 25, 1903, when the Washington Water Power Company commenced furnishing service in the district and since that time the additions have been too numerous to chronicle.

When the mines were first operated in the Coeur d'Alene district, water power was used to a considerable extent and the heavily timbered hillsides afforded an abundance of fuel when water power was not available. But with the increasing development of the district the necessity of using more water for concentrating purposes and timber for mining the operators were face to face with the alternatives of shipping in coal for making steam or securing electric power from some source.

A group of the operators in the Coeur d'Alene district decided to have electric power, and in furtherance of this resolution Mr. R. K. Neill in behalf of those interested on August 1, 1900, received from Mr. Frederick Post, a deed to the water power, and the necessary real estate at Post Falls.

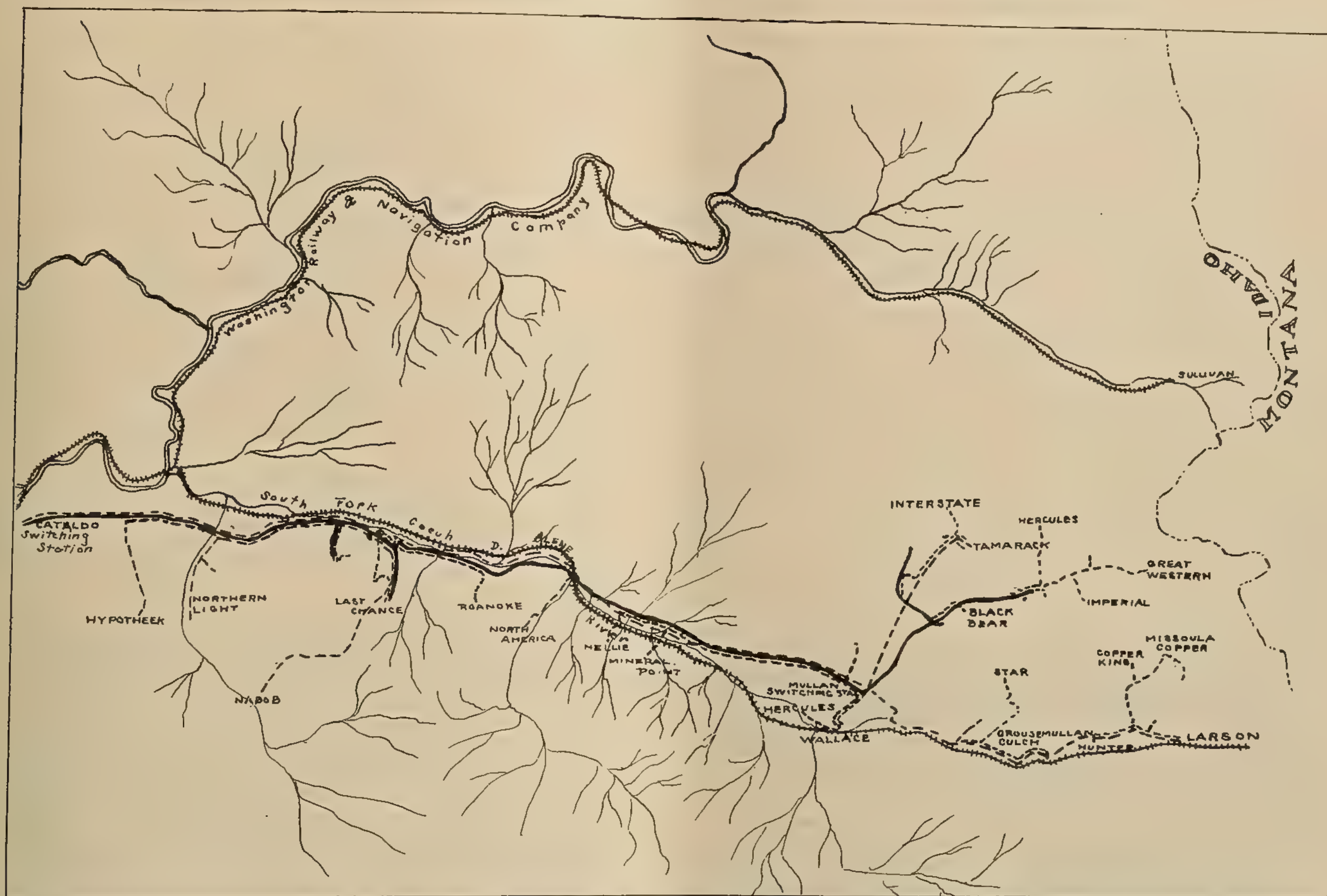
Plans were started looking toward the development of this power, and the construction of a transmission line, but it early became apparent to those interested, that their business was mining, not supplying electric power, and in January, 1902, the Post

Falls property was transferred to the Washington Water Power Company under an agreement that they would supply power to the mines.

No time was lost in carrying out this agreement and the construction of the transmission line was commenced immediately. As it was a physical impossibility to develop the Post Falls power within the time agreed upon, two 2250 kw. generators were installed with the necessary step up transformers at Spokane, and on August 25, 1903, the line was put in commission as far as Kellogg, thus supplying power to the Sweeney Mill, and the Bunker Hill and Sullivan Mine and Mill. Work was then pushed on the remaining portion of the line and early in November the Burke substation at the terminus of the line was put in.

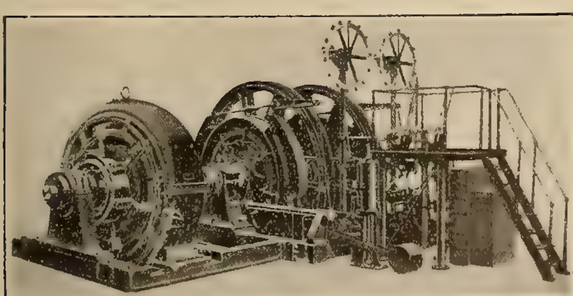
Meantime work had been started on the development at Post Falls and on July 12, 1906, that station was put in commission and run in multiple with Spokane.

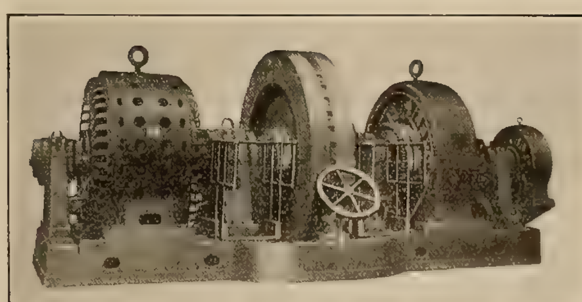
It is interesting to note that the transmission line to the Coeur d'Alenes was one of the earliest long distance lines in this or any other country to furnish 24 hours a day regular service.



Map Showing Transmission Lines Feeding the Mines of the Coeur d'Alene District.

The apparatus at the generating and receiving ends and the line were designed for 60,000 volts, but arrangements were made so that the plant could be operated at 45,000 volts. The latter voltage was carried at the start and in fact until February 2, 1905, when the change was made to 60,000 volts, at which voltage it has remained since.





Details of Electric Hoisting Machinery.

In designing the line the problems were all new, and there was an entire lack of any kind of standard construction.

The business grew. In 1907 it became necessary to build an additional line as far as Cataldo. The

first line was built from Spokane as already stated around the south end of Lake Coeur d'Alene and across the Indian reservation, but the second line was built from Post Falls and the shorter route through the Fourth of July Canyon was followed.

In 1909 the second line was exended from Cataldo to the Sisters Mine, where the present switching station is built. To enable greater facility in transferring the load from one line to the other the switching station at Cataldo, in which oil switches were installed, was built, and air switches were installed at different points to enable the individual loads to be so transferred.

In building the second line which has nearly four times the capacity of the first, an effort was made to eliminate from it those features which had been found to be undesirable in the first line.

Protection of Lines and Quality of Service.

To guard as far as possible from interruptions to the service, these lines are all patrolled once a week and more frequently if necessary. Patrol stations with a patrolman at each station are maintained on each line, at the following points: Post Falls; Opportunity, a short distance east of Spokane; Rockford junction, about six miles northeast of Rockford; Medimont; Wolf Lodge; Cataldo; Kellogg; Mullan Junction and Mullan. At each of the patrol stations an air switch is installed for the purpose of testing the line to locate any trouble that may come on.

Typical Scenery of the Coeur d'Alene Mining District.

Considerable difficulty was experienced at first owing to the lack of inertia in the generating plant. It was found that a mining load was one in which the changes of load were large and sudden. On the other hand it is necessary that a constant speed be maintained for efficient concentration. The memory of the old hoist at the Hecla mine will not be forgotten soon by those who thus endeavored to keep the speed steady.

The speed of an alternating current motor varies almost directly with the speed of the generator and when the Hecla hoist would start at the same time that a compressor picked up load somewhere else, a complaint would be immediately registered from the mill foreman, which was fully justified, as were also the restrictions placed by the Washington Water Power Company on the type of motor to be used for hoisting.

The installation of the splendid apparatus now installed for hoisting at the Hecla did much to relieve the situation, but the best result has come from the fact that the Coeur d'Alene load is now handled from Little Falls and Post Falls, connected in multiple. The stored energy, or fly wheel effect, of the rotating parts in these two plants is so great that all restrictions as to the types of motors to be used have been removed. The plant at Spokane being relatively a small one as compared with the others is not now used for loads outside of Spokane.

Present Status of Substations.

The map gives some idea of the development of the Washington Water Power Company's system in the Coeur d'Alenes. The full line represents the lines as they were in the beginning of 1904, and the dotted lines show the extensions which have been added since that time.

In 1903 there were seven substations with a total transformer capacity of 3350 kw. Today there are eleven substations and a transformer capacity of 13,900.

The original plan followed was to operate each substation from 60,000 volts to 2300 volts and to have them at frequent intervals. The practice now is to install fewer and larger substations and from each substation thus serve a larger territory. This result is achieved by using 6900 volts from the substations and stepping down with open air transformers to 2300 volts at the customer's plant.

Uses of Electricity for Mining.

The uses to which electric energy is applied in mining are many, the principal ones being illumination, milling, hoisting, air compressing, pumping, ventilating, hauling, signalling, firing shots, shop power, etc. Some progress has been made towards reheating compressed air, but this as yet is in the experimental stage. Probably the greatest increase in the future will be in hoisting. In addition to the Hecla hoist already referred to, electric hoists of 150 h.p. each are in successful operation in the Hercules, Gold Hunter and Bunker Hill and Sullivan mines, and the operators of several other mines are at present investigating the subject. This follows as a natural sequence to the greater depth being obtained in mines below the lowest tunnel level.

The facts as set forth in the above description are summarized from my paper presented before the Engineering Societies convention at Spokane, Wash., February, 1913.

ELECTRIC STREET CAR LINE FOR HAWAII.

The incorporation papers of the Hilo Traction Company (Ltd.) organized to equip the city of Hilo with a street car system, were filed at the office of the territorial treasury in Honolulu. The capital stock is $2,000,000, of which $56,000 has been paid in.

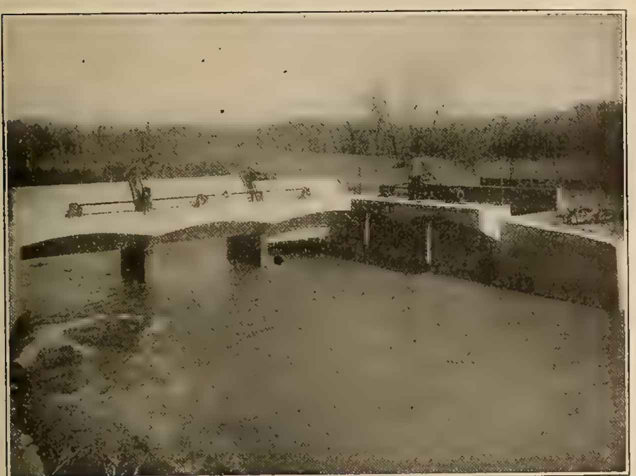
ELECTRICAL PUMPING AND IRRIGATION

WASTEWAYS OR ESCAPES ON CANALS.

BY B. A. ETCHEVERRY.

First Type of Sandbox; Sand and Waste Gates on the Amity Canal, Colorado.

This structure was built in 1905. It is interesting because it illustrates some novel features in irrigation design as well as the adaptability of reinforced concrete for structures where plain concrete could not be used. This structure will handle 870 cu. ft. per second which is the maximum carrying capacity of the canal. It consists of regulating gates across the main canal and of waste or sand gates at right angles. Above the regulating gates and in front of the sand gates is a floor built on two levels; over part of this floor is a cover and between this cover and the floor are sand ducts. The height of the sand ducts is 9 in. at inlet and 18 in. at outlet. The remainder of the floor is not covered but is 14 to 17 in. lower than the top of the cover. Only part of the cover over the sand ducts is permanent, the remainder of the cover being composed of planks made of reinforced cement mortar (1 : 3). These planks may be removed in case of obstruction of the ducts. The planks are 8 in. wide, 1¾ in. thick, reinforced with ¼ in. steel rods. The lengths are 6 ft. 2½ in. and 10 ft. 2½ in. The permanent cover is 2 in. thick and reinforced. The surface of the cover is 6 in. lower than the floor below the gates. This arrangement of the floor and cover is intended to form a stilling place above the gates where the greater part of the sand is deposited. The sand ducts are intended for guiding racks to direct the discharge of the silt towards the sandgates. The cover is necessary to prevent the sand between the racks from being disturbed and picked up as it passes with increased velocity through the regulating gates. This effect will not be felt away from the regulating gates where the floor is not covered.



Upstream View of Sand Trap on the Amity Canal, Colorado.

The regulating gates control the flow of water in the main canal. They consist of three openings, 12 ft. wide, separated by buttresses 10 in. wide supporting the reinforced concrete operating platform. The maximum depth of water above the gates is 6 ft. Each opening is closed with a gate which has the form of a segment of a circle and revolves around a horizontal shaft to which it is attached by means of a frame built up of steel angles. The gates are raised with a worm gear hoist. The sand gates are similar in design and consist of two openings 10 ft. wide. The maximum pressure on the gates closing these openings is 8 ft. 5 in. The advantage of this form of gate is that the lifting force depends very little on the water pressure as the resultant water pressure passes through the shaft on which the gate is hung and the lifting force is equal to part of the weight of the gate, plus the force necessary to overcome the axle friction (which is very small) and the friction of the gate on the buttress. To make the gates water tight, the bottom of the gate rests on a wood cushion and to the sides of the gates rubber belting is fastened which bears on the steel sliding plate, bolted to the buttress wall. The water pressure presses the rubber belting tightly against the buttress wall. These radial gates permit a wide opening which is advantageous when, as in this case, the water in the canal is liable to carry ice, that with narrow openings would cause ice jams. The face of these gates is built of reinforced concrete ¾ of an inch thick. The reinforcement consists of ¾ in. expanded metal No. 13 fastened to the steel angles of the frame by means of U bolts.

The foundation of this structure consists of 12 in. concrete piles resting on sandstone, three under each buttress wall of the regulating gate, two under the floor above the regulating gates and one under the floor below the sand gates. Supported on these piles are reinforced concrete beams on which rest the floor. To prevent undermining the sheet piling at the upstream end, the concrete walls at the downstream end extend from the floor to the impervious sandstone stratum. The structure contains 230 cu. yds. of concrete, consisting of 95 cu. yds. of reinforced concrete and 135 of plain concrete, and required 1151 cu. yds. of excavating. The itemized cost of this structure was not obtainable. The total cost is as follows:

Excavation, concrete work, backfilling complete	$4,160.08
Structural steel for radial gates	953.52
Hoisting devices for radial gates	275.00
	$5,388.60

Second Type of Sand Box.

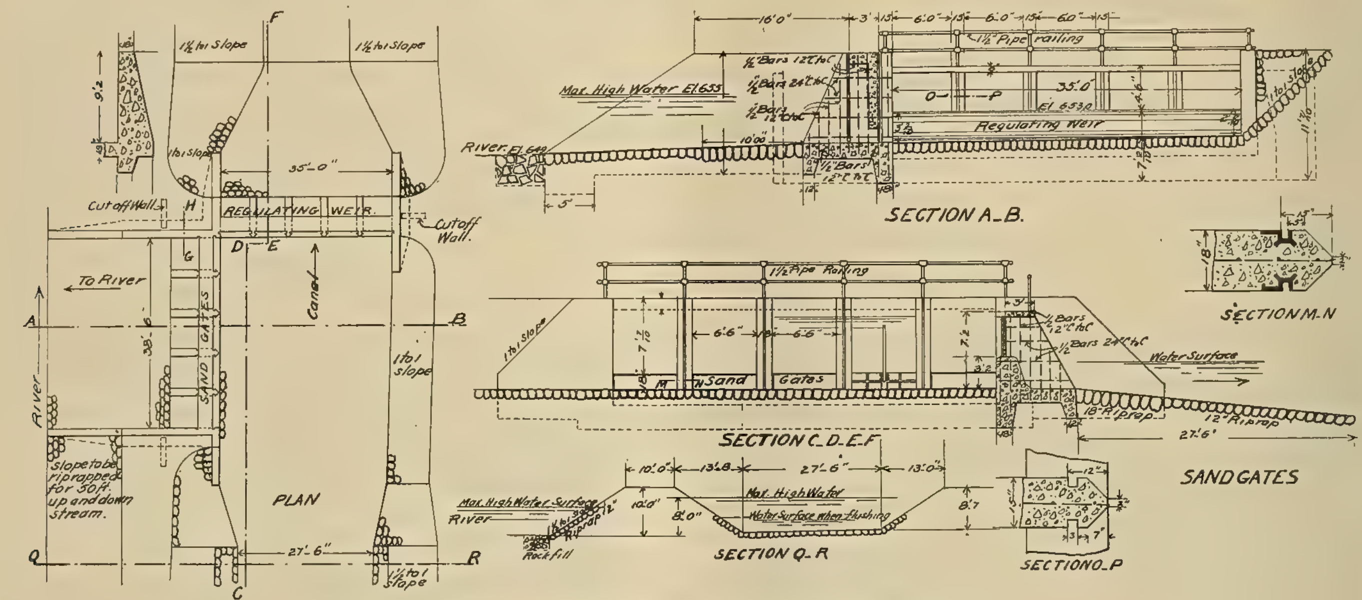
This type of sand box consists of the settling basin, sluice gates, and the waste canal. The settling basin may be of the following three forms:

1. A section of the canal is enlarged sufficiently to obtain a low velocity which will permit the deposition of silt and scouring gates are placed at the lower end of the section. They must be placed sufficiently low to obtain a high velocity through them and must be of sufficient capacity to produce a scouring velocity

in the canal. The scouring effect is greatest just at the gate and diminishes with the distance upstream. For that reason a long section of canal is not necessary or desirable. The sand gate is often placed at a short distance below the headgate and it is possible to increase the scouring effect by forcing through the section when the escapes are opened a volume greater than the full normal capacity of the canal. A structure of this type is the Umatilla sandgate and wasteway described further.

2. The settling basin is formed by depressing the floor of the canal and enlarging the cross section for a length of canal much shorter than in the form described above. The sluice gates are placed at the lowest point of the basin. The sides and bottom are generally lined with concrete and in some cases warped inlet and outlet wings are necessary to obtain a gradual change in velocity. The length of the basin should be at least four times the depth of water in the canal and preferably more. With this form of basin the scouring effect of the gates is concentrated in the basin.

3. The settling basin or box is similar to the second form but is subdivided into a number of compartments separated by overflow walls placed at right angles to the axis of the canal. The water enters into the first compartment, passes over the overflow walls into each one in succession and deposits sand and silt which is flushed out through sluice gates placed at the lowest point of each compartment. This form of basin has been used in many cases in southern California where it is desired to remove the sand and silt before passing water into pipes used for irrigation or power. For small volumes of water this form of settling basin is probably the most efficient. An example is the sand box of the Hemet Land & Water Company, Riverside, Cal., described further.



Sand Gates and Regulating Weir, Umatilla Project, Oregon.

Umatilla Sand Gates and Wasteway.

This structure is 1300 ft. below the headgates and is intended to regulate the flow of water in the main canal and to keep the silt out of the main canal below. It consists of a regulating weir and gates across the main canal and a set of sand gates at right angles, adjacent and upstream of the regulating weir. The sand gates discharge in the river which is parallel to the canal and very near it. The crest of the regulating weir is about 3 ft. higher than the bottom of the canal above the weir and about 5.8 ft. higher than the bed of the canal below the weir. This forms a stilling body of water above the weir, where sediment is deposited. The sand gates are on the same level as the canal and permit the flushing out of the silt. The regulating weir is designed for 300 second feet and consists of 5 openings 6 ft. wide, separated by reinforced piers 15 in. wide and regulated by flashboards. The sandgates consist of five gate openings 6 ft. 6 in. wide and 18 in. high, separated by piers 18 in. thick. Above the gate opening and between the piers are panel walls or curtain walls 12 in. thick reinforced with ½ in. bars. On top of the piers is the operating platform with hoisting device for the five cast iron gates. The foundation is in gravel. Wing walls and cut off walls project 4 ft. below the bed of the canal. The canal and river bed and banks are protected with riprap.

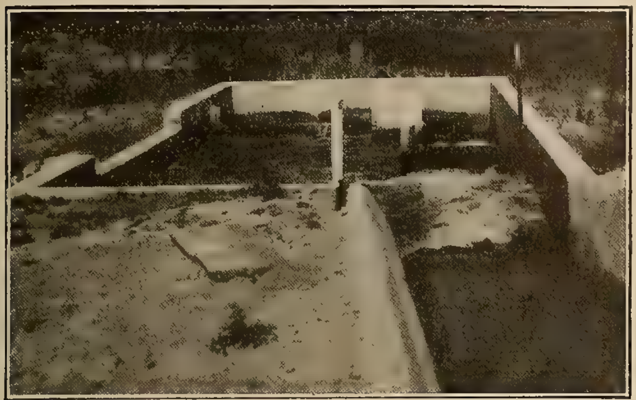
The freezing weather and the high water in the river increased the cost of construction, seepage water standing to a depth of 2 ft above the bottom of excavation. The concrete used was mixed in the proportion of 1 :2.5 sand :5 gravel.

The cost of construction is as follows:

	Actual quantity.	Unit cost.	Total cost.
Excavation	219 cu. yds.	$2.74	$ 601
Concrete (excluding cement)	268 cu. yds.	6.83	1,830
Steel reinforcement	1,900 lbs.	.033	63
Cement	338 bbls.	2.17	733
5 C. I. gates and guides	762 lbs.	.074	564
5 hoisting devices	3,425 lbs.	.14 2/3	503
Setting iron and steel	12,945 lbs.	.004	43
Pipe railing			201
Riprap	318 cu. yds.	5.86	1,863
Rock fill, river bank	209 cu. yds.	1.24	259
			$6,660

Sand Box of Hemet Land & Water Co.

This box is divided into three compartments. The water is brought to the box in a cement concrete lined canal and after passing through the three settling basins separated by partition walls, flows over the measuring weir into the pipe. By removing the flashboards indicated on the drawing and closing the entrance to the stilling basin, the water may enter the pipe directly. This may be necessary in case of obstruction of the flushing out gates. The floor of this box is built of boulders cemented together and the walls are built of concrete.



Sand Box, Hemet Land and Water Co., California.

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PROPOSED ENLARGEMENT OF ELECTRIC-SUPPLY PLANT FOR CANADIAN CITY.

The city of Birmingham is considering an increase of the electric light facilities at a cost of almost $5,000,000. This money would not be spent at once but as needed to meet the demand for electric current.

IRRIGATION FOR PUMPING.[1]

BY E. V. BERG.

Included in a pumping system are the pump station, the pipe lines and the canal distribution system with headgates and measuring devices. While the discussion will hold for any kind of pumping units, the writer has confined himself to the electrically driven centrifugal pump combination, which is the usual style of mechanical irrigation unit in this State.

There are two methods of power charge in vogue—the meter rate with a fixed minimum and the flat rate. Both ways of charging have advantages though the meter rate is apt to be more favorable to the consumer. The feature of the meter rate, is, of course, that you pay for just what you use. It gives the operator a chance to economize, to take advantage of moist springs and rains during the growing season and by watching the water users pumping may be regulated so that there is no needless waste of power. In most cases, the landowner or power user is not the power owner, but must buy the current which runs his machinery from some private power company. This power cost is usually the main item of expense in operating a pumping project. On the flat rate basis, a seasonal charge of a certain amount per horsepower is made figured on a certain short time maximum of power used during the season. In certain cases where the majority of the acreage is in cultivated crops, like fruit, potatoes, corn, beans, etc., it may be possible by early watering and much cultivation to keep the peak load down, but in case the tract is set to diversified crops, such as grain and alfalfa which are not cultivated and which must have a large amount of water during the hot weather, the peak is bound to be high. However, whatever the method of charge, the power bill is always the largest item of expense, and therefore in order to keep down the total cost all parts of the system should be designed with great care so that operation may be conducted with the greatest efficiency in every particular.

An attempt will be made to show briefly what some of the elements are that make for efficiency. In an analysis of the losses which are chargeable to the pumping system, it is necessary to begin at the low tension or meter side of the transformers. The wiring and switch loss between transformer and motor in a properly designed plant is negligible and need not be considered. Passing then to the motor, whether induction or synchronous, we find that for practically all standard makes a certain high degree of efficiency has been reached. For motors of 100 h.p. 90 per cent is usual, while for sizes above 500 h.p. 94 per cent or 95 per cent is not uncommon. This appears to be about the limit of efficiency to be attained in this kind of a machine, including as it does, all mechanical and electrical losses. Alternating current motors are made to run most efficiently at one speed and when running at full load, and any appreciable variation in speed or load is made at the expense of efficiency. The electric motor for pump drive is ideal. It is simple and reliable and has a high efficiency. The centrifugal pump has not yet attained the effi-

[1]Delivered before the Fourth Annual Convention of the Idaho Society of Engineers.

ciency, but in simplicity and reliability is a worthy partner of the motor. Water, being material and having inertia, is accompanied by more losses when passing through a pump than is the corresponding flow of current through a motor and hence pump efficiency is lower than that of motor. Some of the losses which contribute to a decreased pump efficiency will now be reviewed. One of the sources of mechanical loss is poor stuffing box design. A roughly made or short box will allow air to enter or water to escape from pump, unless the gland is drawn up very tight and packing compressed to such a degree as to heat. The only other place where mechanical friction comes into play is in the bearings. These should be ring oiled and the babbitt properly grooved to distribute the oil uniformly over the whole length of the journal. In case thrust bearings are required a proper pressure balance on the impeller or special provision in the bearing itself must be made. The mechanical losses are frictional and incident to all machines. The hydraulic losses are more complicated and are peculiar to the centrifugal pump and the water turbine. They are due to friction and shock, shock being caused by changes in velocity at the various points of passage through the pump.

The suction intake should be of ample size and whatever bends or elbows are necessary should be of long radius. On entering the impeller, a sudden increase in speed takes place, and some degree of churning, causing a small loss of power at this point. If the impeller is constructed according to proper design, the blades are few in number and as short as possible for the given speed. The metal should be smooth and blades curved in such a way as to give the greatest hydraulic radius at every successive point in passing through the impeller, i.e. the water cross section as compared with the wetted perimeter should always be a maximum. Under these conditions the friction and shock losses will be a minimum. Upon leaving the impeller and before entering the guide vanes, is a space only a fraction of an inch in width, somewhat similar to the air space between rotor and stator in the induction motor. Water under pressure passes through this space and back into the suction chamber to be repumped. The loss at this point in a carelessly made machine may be considerable, but where proper workmanship is applied the loss is small.

In entering the guide vanes, if there are any, the water is directed so as to cause the smallest loss due to cross currents and eddies which would be likely to occur if the water entered the casing directly. The guide vanes and casing should be built so that the change from velocity head to pressure head at pump discharge shall be as gradual and uniform as possible, which will then convert the largest per cent of velocity into pressure head.

The sum of all the losses in a good pump amounts to about 25 per cent of the power input on the shaft. This would represent an efficiency of 75 per cent. In special cases or where unusual refinement was attained 80 per cent or even 85 per cent has been reached. As these figures correspond with the best turbine efficiencies, it would seem that the limit has practically been reached for this kind of a pump.

In the general plant layout, economy is promoted, if the total power requirement is divided into several medium sized units instead of one or two large units. This is done to supply the necessary water at the various seasons, without running a large machine when only a small amount of water is needed. In case there are two lifts but all the machinery in one building, it would tend toward economy to have one unit designed for the high lift, but only about one-half the size of the remaining units. The piping could be so arranged that by manipulation of the valves, discharge could be either in the high lift pipe or in the low lift pipe. This scheme of pumping into one or the other of the ditches would be advantageous for early spring or late fall stock and domestic water.

The next link in the chain is the pipe which conveys the water from the pumps to the canal or reservoir at the upper level. For a given amount of water the efficiency of any pipe is directly proportional to diameter and inversely proportional to length. A pipe would be 100 per cent efficient if it had no length or if it were infinite in diameter. The length of the pipe is a fixed condition and is determined by the contour of the ground for any given elevation, but the diameter may vary within wide limits. In fixing the size of pipe we can resort to the same methods used in determining the size of its electrical analogy, the transmission wire. In the latter case, either of two methods are applied, viz: Kelvin's Law, in which the interest on investment is made to equal the cost of the losses, or, a certain arbitrary loss in per cent of total power is allowed and size calculated to conform to that condition. The first of the two methods would be applied something as follows: compare two sizes of pipe in total cost of installation then figure interest on the total cost and depreciation on the material cost only. The sum of these two items for each pipe gives the comparative money value of the investment. Now, the larger pipe will, of course, show the greater cost but will also show the greater efficiency. If the increased efficiency of the larger pipe indicates a greater power saving than the extra interest and depreciation cost, then the larger pipe is the one to adopt. According to the other system a certain per cent loss is allowed in the pipe and the size calculated therefrom. The writer has used a method which seems reasonable and satisfactory, as follows: Allow 3 per cent loss in pipe for first 3000 ft. of length when pipe is carrying one-half its full load capacity, and allow 1 per cent in addition for each additional 1000 ft. in length. The reason for using one-half the maximum is that this is roughly the average amount of water carried during an irrigation season. Thus for example, a wood pipe is to carry a maximum of 20 sec. ft. to a height of 40 ft. Since power required is directly proportional to head, a loss of 3 per cent would be equivalent to adding on to total head 3 per cent of itself or in this case, 1.2 ft. Now this 1.2 ft. is available to be used up by friction and velocity head and it is found that for a 1000 ft. length a 26 in. pipe will carry the required 10 sec. ft. for a pipe 2000 ft. long this allowable loss must be distributed over twice the former length and it is found in this case that a 30 in. pipe would be required. Likewise a pipe between

2000 and 3000 ft. long would have the same given losses distributed over three times the length and a 32 in. pipe would be required. When pipe exceeds 3000 ft. it is found that adding 1 per cent allowable loss per 1000 ft. is sufficient to take care of the additional loss and the size of pipe remains the same as for 3000 ft. length. According to this system, pipes for low head figure out larger than pipes for higher heads, which is as it should be, since high pressure and smaller pipe is about the same price as low pressure but larger pipe.

The next item in the irrigation scheme is the ditch system. The proper laying out of the ditches is very important since it would be useless to have great machinery refinement and then allow canal losses which are to a great extent avoidable.

The writer is a believer in parallel canals. This, not only for the reason that it is more economical to pump to different elevations, rather than all the water to one high elevation, but from the fact that each of the parallel canals, except the upper one, will catch any waste there may be off of the land immediately above. It is true that two parallel ditches would cost more to construct and the seepage and evaporation losses might be a little greater, than in the case of one large canal of the same capacity, but this extra cost and extra losses are compensated for, in that fewer laterals need be constructed to bring the water within specified distance of the land to be watered. The canals should be built with the largest hydraulic radius practicable for the given grade as this will insure the least seepage and evaporation losses. Concrete lined canal wood pipe or oiled canal would add greatly to the efficiency of the system as the losses from seepage would be reduced to a minimum and in the case of concrete lining, or wood pipe, the ditch maintenance cost would be almost eliminated. There may be cases, where the concreting of a canal right at the beginning, expensive though it be, might be an actual saving when total cost of project is considered, for approximately half the yardage would be saved over an earthen canal and the saving in water might be sufficient to warrant a great reduction in size of pumping plant, pipe lines and other works. An important part of the ditch system are efficient and accurate measuring devices, so that the ditch rider may know to a certainty how much water each irrigator is getting. It seems to be human nature that a man will take as much of a thing as he can get, and this is true of irrigation water, even if he has to waste it to get rid of it. This seriously interferes with the economical operation of a pumping system and the best way to prevent it is by the use of proper measuring devices.

Under a pumping system, a certain measure of control should extend over the landowner's operations. Anything that may add to the economical use of the water after it leaves the main, or as they are usually called "company ditches" should be impressed on the farmer. Each farm should be required to be properly laid out as to head and waste ditches, direction of furrows or corrugations, etc. It has been thoroughly demonstratetd that runs should not be over 400 ft. or 500 ft. long between head ditch and waste ditch, for the most economical duty of water and this practice should be advocated. There could be some regulation as to location of various crops on a farm, i.e. those requiring a large amount of water to be at upper end of farm nearer the source of supply and below the cultivated crops which require less water and can utilize whatever waste there is off of the upper field.

On the tract with which the writer is connected, it is believed that a system of maintenance and operation charge will be tried whereby a certain fixed sum, probably about 2/3 the total estimated cost of the season, will be charged against every acre of land whether in crop or not, and the excess to be charged to those actually using water and in proportion to the amount used. In this way a careless irrigator would have to pay for his wastefulness, while a good irrigator would be rewarded by having a less maintenance fee to pay.

Pumping for irrigation is a success. There is no longer any doubt about the machinery or the steadiness or quantity of water which can be supplied, but these things are attained at a greater cost than is the case under gravity flow. In order to make up or compensate for this disadvantage, greater refinement and knowledge must be applied in growing crops. If crops can be raised by close application to right principles which will yield a few dollars, more to the acre than anywhere else, the disagreeable extra operation cost has been overcome.

COST OF POWER TO MEET TACOMA BONDS.

BY. A. L. THORN.

Cost and Selling Price of Energy per kw.-hour at Various Annual Load Factors.

Per Cent Load Factor	Cost of kw.-hr. in Cents. Steam.	Water.	Selling Price Per kw.-hr. Water.
15%	1.54	1.52	2.44
20%	1.33	1.21	1.95
25%	1.12	0.92	1.46
30%	1.01	0.74	1.18
35%	0.93	0.64	1.02
40%	0.89	0.57	0.90
45%	0.85	0.52	0.83
50%	0.81	0.46	0.75
55%	0.78	0.42	0.68
60%	0.75	0.39	0.60
65%	0.74	0.36	0.55
70%	0.7250	0.3350	0.48
75%	0.71	0.31	0.48

Note:—These values are based on the assumption of a fixed annual charge of $13.60 per kilowatt plus an output charge of 0.5 per kw. hour for the steam plant and a fixed charge of $20 per kilowatt of demand on the water power plant.

In the last column is shown the price, at which energy from the hydroelectric plant must be sold in order to produce a profit of 6 per cent on the investment.

Fixed Annual Charges of Steam and Water Power Generating Plants.

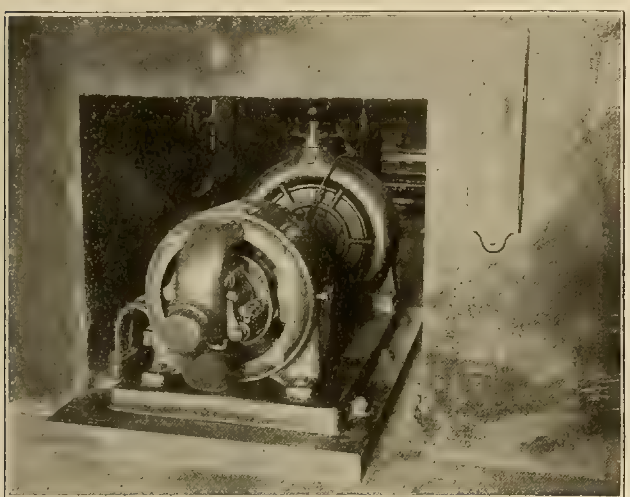
Item.	Per Cent Total Investment. Steam.	Water.
Interest	6.00	5.00
Insurance	0.50	....
Taxes	0.50	0.50
Depreciation	5.00	1.00
Obsolescence	5.00	1.50
	17.00	8.00

ELEMENTS OF STEAM POWER PLANT DESIGN

PIPING AND AUXILIARIES. V.

BY C. R. DELANEY.

In designing a steam plant the size of the piping must be very carefully thought out. If the steam pipe carrying the steam from the boilers to the turbine, is too small there may be considerable drop in pressure and as a drop in pressure of 10 lb. results in an increase of 1 per cent in the steam consumption, this is something that must be avoided if possible. On the other hand, the steam pipe must not be made too large as this will cause waste of heat by greater radiation from the pipes; furthermore, the cost of the larger pipes, valves and fittings must be considered. The size of the circulating water pipes is also an important item. In some cases the power required to force the circulating water through the condenser amounts to 3 per cent of the total output of the turbine. While a great deal of this is due to the friction through the condenser itself, there is often much more friction than is necessary in the pipe lines, and by installing larger pipes the amount of power to move the circulating water could be cut in half, resulting in a saving of 1½ per cent. While the saving of 1 or 1½ per cent appears to be trivial it must be borne in mind that if a 12,000 kw. plant is operated continuously anywhere near its full load, this saving of 1 per cent would amount to over $5,000 per year.



Motor Driven Circulating Pumps. The Use of Electric Motors Prevents Escape of Exhaust Steam From the Roof.

It is customary to operate all the pumps and all the other auxiliaries of the plant non-condensing, and make use of the exhaust steam from them to heat the feed water and the fuel oil. If the plant is properly operated no exhaust steam should appear blowing away from the roof. There is usually no difficulty in attaining this, as when there is a fair load on the plant, the exhaust steam from all the auxiliary machines is not enough to heat the feed water much over 150 degrees. Some gain in economy may be effected by taking enough steam from the first or second stage of the turbine for use in heating the feed water; this, however, involves complications to the piping which are not warranted in the case of an auxiliary steam plant. When the load is light, there is usually more exhaust steam than can be used, and if the plant is to operate at light loads much of the time, it will pay to install electrically driven pumps instead of steam driven.

In designing a steam plant as an auxiliary to a water power transmission system, it is not as important to install the most economical machinery as it would be if the system depended entirely on the steam plant for its power. The extent to which economical machinery should be installed will depend mainly on the length of time it is expected to operate the auxiliary plant during the year. If the plant is merely a stand-by plant and is to carry no load except for short periods once or twice a year, then the efficiency of the plant when in operation is of very little importance. If on the other hand, as is usually the case, the plant is expected to carry a fair share of the load throughout the year, then the efficiency of the plant is of very great importance.

The main difference between an ordinary central station steam plant and a steam plant which is an auxiliary to a transmission system, is in the operating end. Sudden demands for power are liable to occur at any time and the stand-by plant must always be ready to pick up the load and carry it as long as may be required. To keep in readiness for these emergencies it is necessary to have several boilers cut in on the line and if the load is not heavy enough to use the steam from all these boilers, they must be fired one after the other for a few hours at a time so that they will all be hot and in readiness for a sudden demand for steam. Steam turbines operate automatically. If a sudden load is thrown on the station the automatic governor on the turbine immediately opens the valves and lets more steam into the machine to take care of the increased load. The first indication that the men in charge have of a sudden load coming on, is that the steam pressure begins to drop. Then all hands rush to the boiler room, light the oil fires and get all the available boilers in commission. The steam pressure may drop 15 or 20 lbs. but as long as the limit of capacity of the machine at this lower pressure is not exceeded, the turbine will maintain its speed, and as soon as all the boilers are in commission the pressure will recover, and the plant will run along at the increased load as if nothing had happened.

THE PANAMA CANAL AND FOREIGN OPPORTUNITIES.

BY LINCOLN HUTCHINSON.

With the passing of the first ship through the Panama Canal a new era in international trade will have been inaugurated. By 1915, the year of the official opening, the results of the great changes in trade routes will have begun definitely to make themselves felt; a new and broad opportunity will have opened itself before the growers, manufacturers, and merchants of the United States and Europe.

The mere opening of the canal, however, will not in itself produce an expansion of trade. It will only provide an opportunity for development, and this opportunity will be seized upon by all peoples who are eager for trade. Success in the international rivalry thus promoted will depend upon the degree of preparedness which the competitors are able to show and the earnestness with which they pursue whatever advantages they may hold.

The chief exporting nations which are to be affected are the United States and the larger commercial nations of Europe. Most important among the latter will be the United Kingdom and Germany, for they have the greatest interests in the trade whose conditions are to be modified by the opening of the new route. Important also, but to a less degree, will be France, Belgium, Italy, Spain, and Russia. Holland and Austria-Hungary also contribute to a small extent to the trade with China and Japan.

On the other side of the equation will be the lands which provide a market for the goods of the above-mentioned countries—the importers of American and European goods. They naturally fall into two distinct classes: (1) Those which are so definitely within the zone of of influence of the Panama Canal thtt the trade routes to them from the eastern United States and Europe must of necessity be via the new waterway; and (2) those so situated that even after the completion of the canal there will be alternative rival routes still open for use. To the former class belong the countries of the west coast of South America, the west coast of Central America, Mexico, the United States, and British Columbia, and the Pacific islands. The second class will include New Zealand and Australia, the Philippine Islands and the Orient generally, with increasing influence of the canal as one passes up the Asiatic coast to Japan.

Requisites to Successful Use of New Route.

The first prerequisite to success in making use of the opportunities which are to be opened is a clear recognition of the limitations of the new route. Only certain countries, whether they be the American or European exporting nations or the South American, Australasian, or oriental importing ones, are likely to be affected, and these in differing degrees.[1]

The second prerequisite is an intelligent knowledge of the trade and trade conditions of the lands whose markets are to come within the influence of the new waterway. The trader in America or Europe who best understands the character and quantity of goods which the markets are demanding and the ability of the various exporting countries to supply those demands will be the best position to profit by the new developments

Countries to Be Affected by Opening of Canal.

For the purpose of this comparison, the importing countries in any degree affected by the opening of the canal are taken to be: Chile, Bolivia, Peru, Ecuador, Colombia, Costa Rica, Nicaragua, Honduras, Salvador, Guatemala, Mexico, New Zealand, Australia, China, Japan, and the Philippine Islands. Panama and British Honduras, are omitted, the former because its trade has been so abnormal during the construction of the canal that the figures can form no reliable index of what the future is to be, and the latter because, having no frontage on the Pacific, it does not come within the direct influence of the canal. Of the East Indies, only the Philippines are included, because the others are regarded as being almost exclusively within the zone of influence of the Suez Canal.

The only European countries which send any considerable quantity of exports to any of these lands are those already mentioned in an earlier paragraph—the United Kingdom, Germany, France, Belgium, Italy, Spain, and Russia. They, with the United States, are the only ones which can be said to be, in any marked degree, competitors for the trade.

During the five years 1907-1911, these eight countries exported to the 16 purchasing countries mentioned, merchandise to the average value of $717,200,000 per annum. This is a very considerable business and it is increasing rapidly. If we compare the five-year period 1907-1911, as above, with the two preceding five-year periods we shall find that in every one of these countries and groups of countries there is steady growth of purchasing power, with the single exception of China. In the latter's case the decline in recent years is readily accounted for by the political crisis through which that country has been passing and the inflation of its imports during the Russo-Japanese war which made purchases abnormally large during the second period, 1902-1906.

American and European Exports to Purchasing Countries.

The following table gives the European and American exports of merchandise to the countries named, in annual averages for five-year periods, the values being stated in millions of dollars:

Exported to.	1897-1901.	1902-1906 Value.	1902-1906 Increase over first period.	1907-1911 Value.	1907-1911 Increase over second period.
Central America and Colombia	23.3	27.8	19.3	33.3	19.8
Mexico	48.9	77.0	57.5	92.4	20.0
Bolivia, Chile, Ecuador and Peru	41.4	63.6	53.6	90.3	42.0
China (including Hongkong)	82.7	146.8	77.5	136.9	6.8
Japan	73.3	89.3	21.8	113.5	27.1
Philippines	8.9	14.8	66.3	22.6	52.7
Australia, New Zealand, Fiji, etc.	153.7	166.6	8.4	228.2	37.0
Total	432.2	585.9	35.6	717.2	22.4

It will be noticed that the rate of increase between the second and third periods (22.4 per cent) is somewhat less than that between the first and second periods (35.6 per cent). This is caused by the low increase in Mexico (20 per cent) and the slight decline in China (6.8 per cent) due to unusual conditions in these two countries. A recovery may be expected before long, and the grand total by the year 1915, the date of the official opening of the canal, will unquestionably be at least a billion dollars.

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Sworn to and subscribed before me this 20th day of March, 1913.

(Seal.) J. W. COOK,

Notary Public in and for the City and County of San Francisco, State of California.

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CONTENTS

World-Wide Commission Regulation

Citizens of the Pacific Coast states have abundantly indicated in recent months their firm confidence in commission regulation of public utilities. Washington, Arizona and California first took the lead, while Oregon is at present perfecting her commission organization and the state legislatures of Montana and Idaho have just enacted splendid legislation looking toward reasonable commission control. Though the idea of commission regulation is a child of recent birth, so far as Western agitation is concerned, yet it has amply demonstrated its right for existence when properly constituted. A commission fostered by citizens of high ideals and composed of men of integrity with a goodly mixture of brains, brings about results that may well be courted by corporation and people alike.

The utility regulation idea has now grown beyond the bounds of state or even national confines. To the student of progress, it is not difficult to see in present international tendencies a faint beginning or demand for regulation of public utilities, international in its sphere of action. As an instance we cite the Panama Canal. This project represents the nerve and daring of a brave people, a nerve and daring backed by sums of money so stupendous in their outlay as to record a high-water mark for similar national projects of the world's history.

No matter how the facts may ultimately develop in the protest of Great Britain over proposed or supposed discrimination in canal rates, we can not but recognize in this protest an embryo germ for public utility regulation. The age ahead is unquestionably one of far reaching upheaval against all that savors of unscientific and uneconomic development, a protest against special privilege and unregulated monopoly. To produce the world's supply of human necessities at the least cost of human effort is the slogan ahead.

The commission regulation idea first became manifest in the municipal struggle on the part of the people against those controlling the necessities of life—heat, light, water and transportation. In California this idea has grown into state control, which now justly proposes to exert its influence to curtail the unreasonable rates in proposed sales of water even by a city to its surrounding neighbors, maintaining with perfect justice that the people when operating public utilities themselves, have no more right than private corporations to "charge all the traffic will bear."

While we believe the present state of evolution in regulation is perhaps unprepared to grapple with the stupendous task of regulating international outrages in unconstrained monopoly, yet it is a fact that the growth of international commerce is becoming so dovetailed with daily human existence as to demand such a commission at an early date.

From statistics published on another page of this issue, it is seen that the sixteen countries affected by the opening of the Panama Canal purchase in foreign supplies over $717,200,000 per annum, forty-nine per

cent coming from Great Britain, twenty-eight per cent from the United States and thirteen per cent from Germany.

The countries bordering on the Carribean Sea use millions in supplies that may be produced in Pacific Coast states. As pointed out by Secretary Knox in San Francisco some months back, Western men will find in this territory a splendid new field of endeavor. Electrical supplies and engineering talent are even now going forth in ship loads from Western ports to many of these new opportunities. Any regulation either in commerce or public utilities must perforce deeply affect Western enterprise.

Many argue that the Hague Tribunal is the proper place to refer such regulation. If this is true, experts clothed with ample power should be employed to properly constitute such a world-wide effort. Since, then, an international regulation commission must come sooner or later, it is to be hoped that the broadest possible range of action may be read into its constitutional powers.

Electricity in Mining

It is interesting to note how different mining communities have solved the uneven jerks in load, due to sudden calls for power in the electrical operation of mines. The concentration of ores for most efficient results requires an even, steady speed from the operating mechanism. The hoist or haulage system suddenly put in motion, compounded with the heavy and fluctuating demands of the air compressor, have consequently made many a mill foreman's life anything but a bed of roses.

In the Butte mines the construction of a central compressed air storage system thus allowing the compressors to operate continuously and under steady load conditions, has worked out a remarkably even load factor for the hydroelectric system driving them.

In the great Coeur d'Alene mining district of Idaho, on the other hand, an equally commendable scheme has been devised. This territory is largely served by the Washington Water Power Company. Due to the effects of the highly inductive load experienced in this distributing network and the consequent overheating of the generating apparatus, this company was one of the first to penalize mining companies for their low-power factor. This was largely accomplished by putting a clause in the contract that power should be sold on the basis of kilovolt amperes indicated instead of kilowatt consumption of electrical energy. In addition, heavy restrictions were put upon the type of motor to be used in the hoisting apparatus. Thus at the Bunker Hill and Sullivan mine in 1908 an interesting evolution in auxiliary mining apparatus was experienced. During the previous season this company had purchased a steam turbine to assist a direct connected hydraulic unit during low-water season and at times of excessive air compressor operation. After a series of tests it was found more economical to actually cease operating the steam turbine as a prime mover. Thus the turbine was allowed to "float" on the line and the power factor of the load was wonderfully bettered. This was one of the first instances of this practice, which has now become quite general throughout the West.

Not only has the Bunker Hill and Sullivan thus aided in the general power factor improvement, but many of the other mines, too, are wonderfully assisting. Thus the new apparatus at the Hecla, where sudden hoisting fluctuations are traditional, has materially improved the entire district. As in the many-plant hydroelectric networks of California, however, the most good has been accomplished by the inertia or flywheel effect felt from the Little Falls and Post Falls plants operating in multiple, thus adding their combined steadying characteristics.

It is surprising, too, to what extent modern electrical applications have invaded the mining field. While the mining engineer always prefers to purchase his electrical power since he is in the mining business rather than electrical generation of power, still in the operation of his mill and mine its uses are manifold. Thus, beginning with the sole use of the electric spark for blasting back in the sixties, modern mining finds electricity indispensable for illumination, milling, air compressing, pumping, ventilating, hauling, signalling, firing shots, shop power and electrolytic assaying with a hundred other possibilities in sight for the near future.

Cost of Power

On another page of this issue may be found the engineer's estimates of the minimum prices at which hydroelectric power may be sold at Tacoma in order to pay interest on outstanding bonds.

One illuminating point stands out most brilliantly in reviewing this tabulated data; namely, that the load factor plays a most important role. Thus, it is seen that when operating on a load of 15 per cent of the total installed capacity the sales from power must average 2.44 cents per kw.-hr. On the other hand could a 75 per cent load factor be maintained an average income of as low as 0.48 cents would pay bond interest.

Again, in casting the eye over the engineer's estimates for steam as opposed to hydroelectric power, interest charges, insurance, taxes, depreciation and obsolescence all total 17 per cent for an annual charge in the case of the former compared with only 8 per cent for the hydroelectric installation.

It is true that in the Tacoma plant the permanence of the construction is a great factor in reducing obsolescence and depreciation, still it is doubtful if 1 per cent for depreciation and 1.5 per cent for obsolescence is anywhere near sufficient charges to allow for these important items, no matter how permanent the structure may be.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

W. I. Otis has returned from a business trip East.

W. M. Deming, sales manager for the General Electric Company, is at San Francisco.

L. N. Peart, superintendent of the San Joaquin Light & Power Company, is at Sacramento.

Leo Kelly, engineer for the Home Telephone & Telegraph Company, of Los Angeles, is at San Francisco.

G. B. Ochiltree, an official of the Pacific Telephone & Telegraph Company, is in San Francisco from Los Angeles.

S. H. Anderson, electrical engineer for the Pacific Electric Railway Company, is a recent San Francisco visitor.

B. F. Pierson, general superintendent of the Southern California Edison Company, is a recent San Francisco visitor.

W. L. Porterfield, president of the United States Long Distance Telegraph Company, is an interested San Francisco visitor.

Norwood W. Brockett, secretary of the Northwest Electric Light and Power Association, is visiting California from Seattle.

E. Podden, president of the Oakdale Power and Light Company of Oakdale, Cal., was at San Francisco during the past week.

Wm. S. Heger Jr., manufacturers' representative at San Francisco, was married to **Miss Adelaide Gregg** at Milwaukee, Wis., on March 24.

F. W. Hoover has resigned as industrial agent of the Southern Pacific Company to take care of the E. W. Clark electric interests at Chattanooga, Tenn.

J. L. Hoke, superintendent of the Pacific Light & Power Corporation, is visiting the central cities of California, including Oakland, San Francisco, and Sacramento.

T. N. Boyer, assistant manager Chicago office General Electric Company, and Mrs. Boyer, were in Seattle for three days recently, returning from a pleasure trip to California.

C. M. Bliven, agent in charge of the Seattle branch General Electric Company, is in San Francisco on a ten days' business trip. In his absence G. E. Swett is in charge of the office.

E. R. Northmore, secretary of the Los Angeles Section of the A. I. E. E., and superintendent of electric distribution for the Los Angeles Gas & Electric Company, is a recent San Francisco visitor.

H. R. Olson, assistant treasurer of the Pacific States Electric Company at Portland, and **F E. Wilson**, assistant treasurer of the same company, located at Los Angeles, are spending a few days in San Francisco.

Carl Bush, formerly with the Western Electric Company as telephone specialist and assistant sales manager, has been made assistant general manager of the A. G. Electric & Manufacturing Company of Seattle.

J. E. Macdonald, secretary of the joint pole commission of Los Angeles, has been called upon recently in Oakland, California, to render valuable advice looking toward the solution of distribution difficulties in that city.

J. A. Spears, illuminating engineer with H. W. Johns-Manville Co. at San Francisco, was married to **Miss Irene Bibb** at San Francisco, March 25, **Hal Lauritzen**, Pacific Coast manager of the Holophane Company, being best man.

H. V. Carter, president of the Pacific States Electric Company, has recently returned from a ten days' trip through Southern California. He reports things brisk in the south and eastern arrivals at the rate of 2000 a day being brought into that section by the railroad companies.

A. J. Quigley, sales engineer of the A. G. Electric & Manufacturing Company with head offices at Seattle, has returned from a two-weeks trip through eastern Washington, calling on the trade at Spokane, Walla Walla, Moscow, Idaho, Tacoma, North Yakima and Ellensburg. He reports conditions throughout the state as very encouraging.

Theo. F. Dredge, manufacturers' representative at San Francisco, has returned from a visit to the eastern factories. While at Chicago he arranged a most successful informal dinner for the Consolidated Engineering Company at the Great Northern Hotel. Co-operation, the subject of the meeting, was fittingly exemplified by the California wine companies who supplied all liquid refreshments without charge.

B. W. Collins, manager of the Northwestern Supply Company and the Pacific Lamp & Supply Company, 707 Commerce street, Tacoma, has been made superintendent of electric works for the city, a position formerly held by him under present Commissioner Lawson. After retiring from the position he spent some time in Alaska and Idaho in mining and hydraulic work. The management of the designated companies was taken over the first of the year. Mr. Collins formerly resided in California, where he was general superintendent of the Monterey County Gas & Electric Company. **A. L. Thorn**, present superintendent of the city's electrical interests, has taken over the commercial management of these interests and will devote his time to the sale of current for power, light, heating and cooking.

R. F. Hayward, Chairman, Western Can. Pr. Co., Ltd., Vancouver, B. C.; **E. M. Breed**, Secretary, Allis-Chalmers-Bullock Co., Ltd., Vancouver, B. C.; **J. R. Read**, Canadian Westinghouse Co., Vancouver, B. C.; **L. C. Robinson**, British Col. Elec. Ry. Co., Vancouver, B. C.; **A. C. Routh**, Northern Elec. & Mfg. Co., Vancouver, B. C.; **F. D Nims**, West. Can. Pr. Co., Ltd., Vancouver, B. C.; **E. R. Northmore**, Los Angeles Gas & Elec. Cor., Los Angeles; **J. E. Macdonald**, 444 Pacific Elec. Building, Los Angeles, Cal.; **G. R. Murphy**, Rialto Building, San Francisco, Cal.; **A. H. Halloran**, Journal of Electricity, Power & Gas, San Francisco, Cal.; **H. R. Wakeman**, Ry., Lt. & Pr. Co., Portland, Ore.; **J. B. Fisken**, Washington Water Power Co., Spokane, Wash.; **J. B. Ingersoll**, Spokane Club, Spokane, Wash.; **C. F. Terrell**, Puget Sound T. L. & P. Co., Seattle, Wash., and **M. T. Crawford**, Puget Sound T. L. & P. Co., Seattle, Wash., have been appointed by President Mershon, members of the Pacific Coast Convention Committee of the American Institute of Electrical Engineers for 1913.

ELECTRICAL DEVELOPMENT AND JOVIAN LEAGUE.

The regular weekly meeting was held Tuesday, March 25th. Among other matters considered was the appointment of a committee empowered to investigate fully the present city ordinances regulating the opening of streets by public service corporations and power companies, and the relation of the latter concerns thereunder, and upon completion of its findings to present same before the board of supervisors of San Francisco in an endeavor to have the present chaotic condition with respect to this question remedied.

The subject of the day—"The Storage Battery as a Business Getter"—was ably and interestingly presented by Mr. Geo. Murphy of the Electric Storage Battery Company.

A. I. E. E. DIRECTORS' MEETING.

At the regular monthly meeting of the board of directors of the American Institute of Electrical Engineers upon March 14th, upon the request of the executive committee of the committee on organization of the International Electrical Congress, San Francisco, 1915, a resolution was adopted, explicitly authorizing the said executive committee to organize the congress, to determine the scope of the papers, to arrange for the publication of the proceedings of the congress, and to arrange the entire program, as implicitly au

thorized previously. Authority was also given for the expenditure of certain sums from the Institute treasury, to cover the cost of carrying out the work referred to above.

The report of the tellers' committee's canvass of the nomination ballots cast for candidates for the Institute offices falling vacant on July 31, 1913, was read. The board then made up its list of "Directors' Nominees" as provided in Section 31 of the Institute constitution, with the following result: For president, C. O. Mailleux, New York; for vice-president, M. H. Barnes Jr., New York, J. A. Lighthipe, Los Angeles, Cal., Charles E. Scribner, New York, W. S. Rugg, New York; for managers, B. A. Behrend, Boston, Mass., P. Junkersfeld, Chicago, Ill., H. A. Lardner, San Francisco, Cal., Lewis T. Robinson, Schenectady, N. Y., Charles Robbins, Pittsburgh, Pa. It will be noted that the board of directors placed on its list of directors' nominees four candidates for the office of vice-president, three of whom are to be elected, and five candidates for the office of manager, four of whom are to be elected.

Oregon Technical Club.

W. L. Brewster, a member of the board of directors of the Library Association of Multnomah county, addressed the club on March 18th, regarding library conditions. J. Andre Fouilhaux presided as chairman. W. H. Crawford and Mr. Curry were appointed on the Rose Festival Committee. Governor West is expected to address the next luncheon on "The Celilo Project and the Old Columbia Southern Reclamation Enterprise." The April 1 meeting will be presided over by Mr. E. A. West of the P. R., L. & P. Co., and he announces as speaker the eminent French bridge engineer, Emil Barnhart, also as a special added attraction the Metropolitan Quartette, and Mr. Schulizh, a recent student of Paderewski.

Oregon Society of Engineers.

At the regular monthly meeting, March 13th, Mr. C. E. Fowler lectured on "Deep Foundations." A committee was appointed to report on a summer trip to Eugene, Oregon. A suggestion of a union of Portland, Seattle and Spokane engineering societies presented by Mr. C. E. Fowler, was discussed. A code of ethics was introduced and referred to committee. Mr. C. F. Stevens of Barcelona, Spain, caused to be presented in his absence, a paper on "Influence of Forest on Climate and Stream Flow." The paper was read by title and ordered printed, when it will be read in full and discussed. At a previous meeting President W. H. Graves announced the following committee appointments: Jas. R. Thompson, chairman membership committee; Wm. S. Turner, chairman by-laws committee; C. F. Blake, chairman library committee; H. L. Vorse, chairman program committee; Orrin E. Stanley, secretary, chairman employment bureau committee.

Portland Jovian Luncheon Club.

At the luncheon March 20th, C. P. Osborne was chairman and a very spirited debate was participated in, by Messrs. C. J. Franklin and E. A. West on the negative, and A. S. Moody and W. F. McKenney on the affirmative, on the subject of "Should Jovianism Endorse Woman's Suffrage." The judges were Messrs. C. L. Wernicke, J. B. Goodwin and J. E. Davidson. The judges rendered a unanimous decision in favor of the negative. The attendance was 60. During the month of April the chairman will be F. D. Weber, electrical inspector Underwriters' Equitable Rating Bureau, Portland, Oregon. The following program has been arranged:

April 3.—Capt. T. B. Steele, U. S. A., "Personal Reminiscences of Thomas A. Edison as a Business Man."

April 10.—Mr. M. G. Hopson, U. S. R. S., supervising engineer, "Conflagration Hazard of Portland."

April 17.—Mr. D. C. Henny, consulting engineer, "The Highest Dam and Largest Reservoir in the World."

April 24.—Mr. Eugene Brookings, President of the Progressive Business Men's Club of Portland, "The New Commission Charter."

ELECTRIC CLUB AT MEDFORD, ORE.

The Electric Club, composed of members of the California-Oregon Power Company, held its monthly meeting on Friday evening, March 7, in the company's club rooms at Medford. Mr. J. D. Sinnott was chairman pro tem for the evening and placed a (1) before March 7 to remind the club that this meeting should have been held on Ireland's day. Tables were set in the club rooms and a "Peak Load" lunch was served starting at 6:30 p. m. The table decorations consisted of a large Shamrock whose leaves covered white paper cups containing salted peanuts and green wafers and butter cups. The menu was a "Peak Load" card, listing: Oyster stew with salted crackers, a la "Walther." Sardine sandwiches with "high tension" mustard. "I Scream" with cake, like the customer with a "Light Bill." "Flat Rate" coffee, "Excited" with cream. "Westinghouse" cigars with "G. E. Lighters."

Mr. George R. Sailor of the Westinghouse Electric & Manufacturing Company, acted as toastmaster for the evening. The roll follows:

J. D. Sinnott, chairman (speaks English, Irish, Latin and Westinghouse).

L. G. Fear, R. A. Balzari, T. R. Jump, Geo. R. Sailor, W. M. Bernie (all from the We-Sting-House).

O. B. Helt (from the Gee Yee Company), D-Quid is on your trail.

H. L. Walther, (Here, there, everywhere,—Swears a little).

Sidney Sprout, ("Often consulted").

H. C. Stoddard ("Statistics"—Cat. No. 23, Page 15, Line 7.)

O. G. Steele, (Some swift—at any old job. No pushee,—No pulle, Go-ee-like-Hell-ee).

T. G. Bradley, ("Hatless dispenser of Lead Pill").

A. C. Hough, (Ounce of preventive, worth a pound of cure").

R. W. Clarke, ("Very much just so, so").

G. J. Walton, ("Can't join any more lodges").

C. A. Malone, ("Irish Politician").

E. E. Ebell, (Dollars and sense—Figgers. Loud Reports).

F. F. Loder, "Now you see him, now you don't").

J. J. Butcher, ("Bing, Bang, Biff, Jerk").

W. H. Sears, ("C. O. P. Comedian and Cartoonist").

C. W. Martin, (Dignified gent who never sleeps, a-la-Edison,—Just works).

Don Colvig ("Just Papa").

M. Stephens, ("Printer—chews horseshoe").

F. C. Chamberlain, (Superintendent Fobes Supply Co., Religious Department).

O. O. Alenderfer, (Sells you something, then makes you deliver the long green).

A. B. Cunningham, ("He who worries—Nix").

C. G. Ware, (Doesn't mind draughts. Rain and storm cut no ice-prints by Arc).

F. O. Stinson, (His swear word, "Oh, my Goodness")

H. C. Purucker (Whoop-ee! Kee-Hoo! Hear him 7 blocks).

Walt Randle, (The Mushroom King from Grants Pass).

B. O. Wilkinson, (Plays Arkansas Traveller fine on the Fiddle).

R. C. Curry, ("The Stove I Built")

Clyde Dean, Cupid Chaser—Young yet.

C. S. Cole, (Mud-slinger—with the old Buick).

E. G. Henselman, ("Sherlock Holmes").

C. G. Conwell, (Diplomat (?)),

E. G. Darnielle, ("One of my men"—G. B. C.)

Herbert Alford, (Scene shifter for the Magic Lantern).

TRADE NOTES.

Davis & Hull, 942 Commerce street, Tacoma, have the contract for installing the wiring in the $40,000 hotel building to be erected by the Pacific Malting & Brewing Company at Ruston, Washington.

The Standard Engineering Company, 273 Colman building, Seattle is now purchasing material for the installation of a lighting system at Boise, Idaho. Ornamental posts will be used and 215 arc lights installed with underground wiring.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

EXAMINATION FOR DEPUTY INSPECTOR OF ELECTRICITY, PORTLAND, ORE, DEC. 10. 1912.

1. (a) Does a condenser in an alternating current have the effect of increasing or decreasing the resistance? (b) What is meant by a non-inductive load?

2. (a) What are the chief units of electrical measurements? (b) By what term is electric power designated? (c) Can a current of large amperage alone do work? State fully. (d) How is the amount of electrical energy usually expressed?

3. (a) If a motor is taking 75 amperes of current at 220 volts, what horsepower is it giving, the efficiency of the motor being 90 per cent? (b) If a 450 watt lamp takes ¾ ampere current what is the voltage of the line?

4. A generating plant supplies 76 h.p. of current at 110 v. (a) How many amperes is it furnishing? (b) How many 16 c.p. lamps at 3.6 watts per c.p. would it supply?

5. What is the code requirement for the testing of the insulation of new code wire? State fully.

6. If you had a 2-wire, 200 volt, direct current circuit supplying 1-50 h.p. motor and 1-20 h.p. motor, for what current capacity would you have to select your conductors? Give work.

7. Why does the code insist upon the two or more wires of an alternating current system being placed in same conduit?

8. (a) What character of fuses must be used for very heavy currents such as 1000 amperes? (b) Why are they selected for such currents? (c) Why does the kind of fuse used depend on amperage and not on voltage? (d) What is the first essential before there can be a flow of an electric current?

9. (a) What is Ohms law? (b) What is meant by the term "circular mil."? (c) How would you figure the carrying capacity of wires? (d) What is meant by the term "kilowatt hour?"

10. Explain the Edison 3-wire system.

Electrical Wiring and Apparatus.

What are the Underwriters' requirements for:

(1) the connection of exit lights in theaters, auditoriums, etc.?

(2) the installation of lamps and sockets in rooms where inflammable gas may exist?

(3) the use of flexible cord? State at least five of such requirements.

(4) the installation of resistance boxes, rheostats, and equalizers? State fully.

(5) outline lighting on buildings, (other than signs on exterior)? State at least five of the requirements.

(6) for the installation of metal cabinets? State how they are to be constructed.

(7) for the installation of electric fixtures? State at least five code requirements.

(8) (a) Where would you require conduit to be installed in the city of Portland? (b) Explain clearly under what conditions wooden moulding would be permitted in Portland.

(9) Give the requirements of the proper installation of concealed knob and tube work.

(10) (a) How many circuits may be carried in the same conduit? Would you permit the installation of two different systems in the same conduit? Why? (b) How many outlets may be permitted on a circuit in the following places: offices, stores, show windows, residences, signs?

Practical Questions.

1. (a) At what point in the mains should branch circuits be connected? (b) Give an illustration by diagram of a proper and of an improper connection of branch circuits to mains.

2. (a) Draw a diagram of two shunt wound generators coupled in series showing shunt coil, ammeter, rheostat, fuse and switch connection. (b) Draw a diagram of two shunt wound generators coupled in parallel, showing circuit connections of shunt coils, rheostats, ammeters and switches.

3. (a) What are the principal objections to series motor for single-phase circuits? (b) How can sparking at the commutator be roughly measured? (c) Why should starting boxes always be used with direct current motors? State fully. (d) How are small induction motors started? (e) Why can not the larger sizes be started in the same way?

4. Show by diagram external connections of a single-phase motor, including all connections to primary and secondary circuit as is the general practice.

5. How many volts are lost in a circuit carrying 240 amperes and having a resistance of 30 ohms?

6. (a) What in reality is a three-wire convertible system of electric lighting? Explain fully. (b) In a three-wire system how can one find out how much current the neutral wire is carrying?

7. Explain clearly and fully how you would determine if the wiring in a building is properly installed?

8. Explain and give a diagram showing clearly what constitutes the correct method of wiring for meter loops in the city of Portland.

9. What is the difference between a three-wire and a three-phase system?

10. What type of cord would be required in making extensions to be used in basements or in damp places?

NEW ELECTRICAL INSTALLATIONS.

E. L. Knight & Company of Portland, Oregon, have the new department store building located in Canby, Oregon, to wire. The installation will be in conduit.

The Oregon Furniture Company of Portland is now electrifying their factory and will install about 300 h.p. in motors. They are doing their own installation work.

W. L. Bradley & Company are installing the electrical installation in the new Wadhams & Kerr Building, on the northwest corner of Thirteenth and Davis streets, Portland.

The Waverly Golf Club's new club house at the golf club grounds on the Willamette River, is nearing completion. The electrical installation was done by the Morrison Electric Company of Portland, Oregon.

The girls' dormitory of the State Normal School, Monmouth, Oregon, is nearing completion. The electrical installation was all installed in rigid conduit by W. L. Bradley & Company of Portland, Oregon.

The Inman Oil Company's new plant is being built on the bank of the Willamette River, below Portland, and outside of the city limits. It is fireproof throughout. The electrical installation for both light and power is being installed by the Western Electric Works, Portland, Oregon.

The W. H. Smith Electric Engineering Company of Portland, Oregon, are at the present time doing the electrical work on the following buildings: New University Club, northwest corner Sixth and Jefferson streets; new Broadway Hotel, northeast corner Seventh and Burnside streets; Public Recreation Buildings, Peninsular Park; new Western Union Telegraph office, 126 Seventh street; new Waldorf Billiard Parlors, 334 Washington street.

INDUSTRIAL

STORAGE BATTERY CARS IN CALIFORNIA.

At Easton, near Burlingame, only 30 minutes' ride from San Francisco, there is a new electric car which meets the Southern Pacific trains and carries passengers between the depot and the beautiful homes of the residence district. The little railroad runs out about two miles and makes the round trip in 18 minutes. There's never a sign of a trolley wire, or unsightly poles; no "feed" wires, no "bonding" of the rails so the "juice" can find its way back to the power house, and no cranky trolley pole on top of the car to "fly off," and no "turning the trolley" at each end of the line, leaving the passengers in the dark while the conductor "feels around" for the wire.

The power is furnished by storage batteries under the seats, which are "charged" by a motor generator set whenever it is necessary, while the car is standing at the station, and a comparatively small battery charging plant will charge batteries on several cars in turn just as well as on one car.

Storage Battery Electric Railway.

The batteries on this car are no ordinary batteries, either, but are Edison storage batteries, the result of ten years of hard, earnest, personal labor and experiment on the part of Mr. Thomas A. Edison, the greatest inventor the world has ever known, who felt that nature must afford some further electro-chemical reaction other than a lead sulphuric acid combination. The Edison Storage Battery Company, 818 Mission street, San Francisco, supervised the storage battery installation.

AN ELECTRIC COMMUTER.

At the shrill command of his electric alarm clock John Smith, commuter, sprang out of bed in the grey dawn and switched on the electric light. He hastily washed with electrically manufactured soap. A seasoned veteran of the 7:42 express, he wasted few minutes in dressing, but before he was half clad the water was steaming hot in his electric shaving mug. Dashing down stairs he attacked a rapid-fire breakfast of eggs, electrically boiled, toast electrically grilled, coffee electrically percolated, and cream electrically separated from the milk electrically milked from electrically curried cows. He dashed out of his front door just in time to catch an electrically heated and propelled trolley to the railroad station built of electrically manufactured cement. While waiting for the 7:42 express he lighted an electrically made cigarette with an electrically manufactured match. When the express came buzzing up, Mr. Smith settled down in the smoking car to read his electrically printed morning newspaper.

Arriving in town he descended into an electrically lighted subway through which he was whisked on electric cars safeguarded by electric signals. He ascended to his twenty-story office in an electric elevator and touching an electric button summoned a stenographer with electrically curled hair who operated an electrically manufactured typewriter with electric—

Enough?

But it's not a joke!

One could take John Smith through every minute and hour of his business day, follow him back home again until he turned in for the night—and every minute and hour of that day and night would be made in some way more convenient and comfortable by the marvels of electricity. There are hundreds of thousands, millions of John Smiths in every great civilized country today.

The change has come so gradually that we do not realize what a revolution electricity has wrought in modern life. There are few uses to which electricity is not put in modern industry and up-to-date households. For an infinite variety of work ranging from milking cows to making ice cream, from running sewing machines to washing dishes, from the manufacture of locomotives to the making of wall paper, effective and economical use is now made of electrical apparatus. Recently the Crocker-Wheeler Company made a tabulation of the purposes for which one type only of their motors was used, and the following list includes only a small part of the products electrically manufactured: Automobiles, barrels, baskets, boats, bolts and nuts, boots and shoes, bottles, boxes, bricks, brooms, candles, cans, carriages, cartridges, cement, chains, chairs, cigarettes, cor-

dage, corks, elevators, envelopes, gun powder, hooks and eyes, hoops, ice, jewelry, locomotives, lead pipes, leather, lumber, matches, nails, oat meal, paint, paper bags and boxes, pins, pottery, presses, rivets, rubber, silk, soap, spools, tacks, textiles, typewriters, wagons, wall paper and wire.

AN OLD SAWMILL ELECTRIFIED.

The Liedinghouse Bros.' mill at Dryad, Wash., has just recently been electrified throughout.

The planing mill and back end of saw mill were electrified some years ago. The motors were furnished by the General Electric Company and consisted of the following:

2-50 h.p., 220 volt, 3-phase, 60 cycle, induction motor.
2-35 h.p., 220 volt, 3-phase, 60 cycle, induction motor.
1-25 h.p., 220 volt, 3-phase, 60 cycle, induction motor.
2-20 h.p., 220 volt, 3-phase, 60 clcle, induction motor.
1-15 h.p., 220 volt, 3-phase, 60 cycle, induction motor.
1-7½ h.p., 220 volt, 3-phase, 60 cycle, induction motor.
1-5 h.p., 220 volt, 3-phase, 60 cycle, induction motor.

These motors were rewound for 440 volts.

Power had been furnished by 100 kw. belted alternator and an air Atlas engine, which were discarded and sold.

The new equipment for the sawmill was furnished by the Allis-Chalmers Company and consists of the following:

1-250 h.p., 480 volt, 3-phase, 60 cycle, 720 r.p.m. squirrel cage induction motor, direct connected to a circular head saw. This motor is a two bearing motor, and is the second mill in existence where an induction motor has been direct connected to a circular head saw. The first being at the Ferrybaker Lumber Company, Everett, Wash., this motor being a 300 h.p., 440 volt, 3-phase, 60 cycle, 680 r.p.m. squirrel cage induction motor; the motor being a 3-bearing motor. The capacity of this mill is 250,000 ft of lumber in 10 hours.

1-100 h.p., 480 volt, 3-phase, 60 cycle, 1700 r.p.m., squirrel cage, induction motor is direct connected to an edger.

1-60 h.p., 480 volt, 3-phase, 60 cycle, 1700 r.p.m., squirrel cage, induction motor, belted to a vertical re-saw.

1-50 h.p, ditto; belted to a trimmer.

1-35 h.p., ditto; belted to a slasher.

2-15 h.p., 1-10 h.p., 1-5 h.p., ditto; belted to minor machines.

Steam is furnished by the old boilers which are of the tubular return type; the steam pressure being 100 lb.

Power is furnished by 1-750 kw., 80 per cent p.f. 480 volt, 60 cycle, 3-phase, 3600 r.p.m. Allis-Chalmers Company condensing steam turbine. This unit is equipped with a 42 in. x 24 in. Barometric condenser of the Allis-Chalmers Company manufacture; the motor being supplied by a motor driven 8 in. single stage centrifugal pump, direct connected to 1-50 h.p., 1150 r.p.m., induction motor. There are two 15 kw. exciter units, one driven by a motor, the other belted to a steam engine. The above power is controlled by a 4 panel switchboard of the Allis Chalmers Company manufacture.

The capacity of the Liedinghouse Bros.' mill is 100,000-125,000 ft. per 10 hour day. All the auto-starters are equipped with no voltage and overload release devices.

NEW FEATURES ADDED TO CUTLER-HAMMER DRUM TYPE CONTROLLERS.

Sometimes the location of drum controllers makes operation by a straight backward and forward motion of the operating handle a little more convenient than the usual rotary motion in a horizontal plane. The Cutler-Hammer Manufacturing Company, Milwaukee, has, therefore, standardized a vertical arrangement of lever with bevel gear drive than can be applied to the six direct-current types of enclosed drum controllers and the three alternating-current types. The accompanying illustration shows this straight line drive, the lever having a centering latch released by means of the button at the end of the handle as in the case of the horizontal rotating type lever. The operation is very easy and the milled star wheel and notched lever permit all points of control to be distinctly felt. The construction of the drum, non-

Cutler-Hammer Drum Controller With Vertical Handle.

stubbing fingers, arc deflectors, cylinder, etc., remains as in the original line of controllers which was brought out about two years ago. Special arrangements can also be made for rope operation

NEW CATALOGUES.

"Superheating" is the title of a 16-page pamphlet published by the Heine Safety Boiler Company, St. Louis, Mo., comprising reprints and abstracts of technical papers on the subject.

The engineering department of the National Electric Lamp Association, Cleveland, Ohio, have issued in four-page form a chart designed to facilitate the solution of problems in general illumination. Given the intensity of illumination required, the color of the walls and the dimension of the space to be lighted, by referring to the chart one is able to select the most desirable size of Mazda lamp, and the spacing of units to give satisfactory results.

The General Electric Company has just issued an interesting bulletin (No. A4080) devoted to "Electricity in Excavation and Construction Work." The bulletin deals with both the generating of the current and its use through motors. It touches on the advantages to be derived from the use of electric power, and refers briefly to its application to the work in connection with the Panama Canal, Catskill Aqueduct, New York Barge Canal and in general building construction. Bulletin No. A4073 deals with the Electric Equipment of Bakeries. This bulletin refers to the sanitary advantages of such an equipment, the efficiency, economy of space, convenience, cost, maintenance and reliability, and illustrates the various pieces of apparatus used in bakeries, equipped with electric motors. It refers also to the electric lighting and to electrically heated ovens for bakers' use.

NEWS NOTES

INCORPORATIONS.

LEWISTON, IDAHO.—The Lewiston-Clarkston Valley Railway Company has been incorporated by F. L. Sturm, C. F. Osners, S. L. Alford, J. E. Nickerson, Dr. Morris of Lewiston, J. E. Hoober of Clarkston, and E. S. Florence of Asotin. Capital stock, 10,000 shares, of $100 each.

ILLUMINATION.

FORT MASON, CAL.—Sealed bids in triplicate for installing an eletcric light system at Fort Mason, Cal., will be received here until April 4th.

SANTA ANA, CAL.—The West Coast Gas Company is enlarging its plant and installing a high-pressure system to cost $37,750 for supplying New York Beach and Huntington Beach.

CORONA, CAL.—Sealed bids will be received up to May 6th for the purchase of a gas pipe franchise granting the right to construct and maintain a gas plant and laying of conduits in the public streets of the city.

SACRAMENTO, CAL.—The Sacramento Natural Gas Company has applied for authority to sell $200,000 of bonds, for the purpose of liquidating existing indebtedness for the construction of a new gas holder, for the extension of its pipe line and service pipes, and for drilling new wells.

QUINCY, WASH.—The Wenatchee Valley Gas & Electric Company has asked for a 50-year franchise for the transmission of electricity for light and power purposes. It is understood that work on the building of the line would start within five months and would be completed in less than one year.

SILVERTON, ORE.—The city council has resolved that there be submitted to the legal voters of the city of Silverton at a regular annual election to be held in the said city on the 5th of May, 1913, the question of voting or rejecting a $50,000 bond to purchase and install a municipal electric lighting plant.

SAN RAFAEL, CAL.—Manager Wallace Foster of the Pacific Gas & Electric Company, is making arrangements to extend the gas mains of his company to Sausalito and Mill Valley. The mains are now being laid at Larkspur and Corte Madera. It is the intention of the company to extend the mains to Sausalito first and Mill Valley later.

PORTLAND, ORE.—Mayor Rushlight has received a report from J. H. Cunningham, the engineer who was employed to investigate the cost of a municipal lighting plant. The expert bases his report on the development of a hydro generating plant on the Clackamas River, 12 miles from the city, where rights may be obtained. A plant capable of generating adequate horsepower would cost $2,433,000.

TRANSMISSION.

REDLANDS, CAL.—The city trustees with representatives of the Pacific Electric, Edison, Southwestern Home Telephone, and Western Union and Postal Telegraph Companies, held a conference with reference to the order that all poles in certain streets in the business section be removed by September 1. The companies' representatives are seeking modifications of the order.

RIVERSIDE, CAL.—The city power contracts have been awarded by the board of public utilities to both the Southern California Edison Company and the Southern Sierras Power Company. The Edison company has awarded a contract for power at .85 cent a kilowatt. The Southern Sierras Power Company was iven the contract for supplying all that portion of the city south of Arlington avenue, amounting to about 1000 horsepower, with the privilege of increasing the amount, at 1 cent a kilowatt.

PLACERVILLE, CAL.—Judgment in the foreclosure suit of the Placerville Gold Mining Company for $47,972.25 and interest has been filed against C. N. Beal, the Sierra Water Company, San-Francisco-Oakland Terminal Power Company, subsidiaries of the United Properties Company of California; the Mechanics Trust Company of New Jersey and others. The decree is signed by Judge J. E. Prewett of Placer county, who heard the case February 7th, sitting in the El Dorado county superior court for Judge N. D. Arnot. The property involved consists of the canals and ditches in El Dorado and Amador counties waterworks and water system known as the El Dorado Water & Deep Gravel Mining Company's canal and water system.

TRANSPORTATION.

OAKLAND, CAL.—Suburban electric trains of the Southern Pacific will be running to the western city limits of San Leandro by next June.

EL PASO, TEX.—Permission to build an extension of the electric railway through Piedras street from the Fort Bliss line on the Boulevard to Manhattan Heights, has been asked for by the El Paso Electric Railroad Company, and the extension will begin as soon as a franchise is granted.

OAKLAND, CAL.—The first elevated electric railway in California is that portion of the suburban system of the Southern Pacific which touches the Sixteenth street depot. Work on the approaches to the elevated platform of the new depot has been begun, and is being rushed as fast as possible.

STOCKTON, CAL.—The electrification of the Tidewater & Southern Railway from Stockton to Modesto, a distance of nearly 40 miles, will begin within the coming month. Prior to the beginning of this work the construction of the branch line from Modesto to Turlock will be started. For this work there has arrived over the Western Pacific seven carloads of steel and three of spikes, bolts and angle-bars. Five electric cars ordered by the Tidewater are nearing completion and will be ready for delivery in 90 days. All the electric equipment for the road between Stockton and Modesto has been ordered, and the stringing of wires will soon begin.

SAN FRANCISCO, CAL.—The Board of Public Works has provided for the construction of the ocean extension of the Geary street municipal railway, asking the supervisors to set aside $57,400 of Geary street railway funds to cover the cost of the work. Under the plans now accepted the extension will be built from the present terminus of the city line at Geary street and Thirty-third avenue, southward along the avenue for one block to Balboa street, turning into this and following it westward for eight blocks to Forty-fifth avenue, where another turn southward for a block is to be made to Cabrillo street for the sake of an easier grade. Along Cabrillo street the road will be built to a terminal on the Great Highway overlooking the beach.

SAN JOSE, CAL.—A 50-year franchise for a standard-gauge electric railroad over Alum Rock avenue from the easterly city limits of San Jose to the new San Jose Golf and Country Club, a distance of about five miles, is asked

for in a petition filed with the board of supervisors by F. E. Chapin, general manager of the electric lines in Santa Clara county for the Southern Pacific Company. A narrow-gauge line has been in operation over the same road for more than a quarter of a century, and the Southern Pacific recently completed a new line into Alum Rock Canyon and the city reservation by another road through Berryessa, leaving the present line out. The work on the new line to the golf club, which has just completed its new building and grounds, will begin immediately after the franchise is granted. The railroad would pay 2 per cent of its gross receipts annually to the county, after the first five years, for the franchise.

TELEPHONE AND TELEGRAPH.

LOS ANGELES, CAL.—Permission to issue $100,000 worth of bonds has been granted to the Pomona Valley Telegraph & Telephone Union. The company, which serves Pomona, Chino, Claremont, Lordsburg and San Dimas, intends to use the proceeds for the extension of the system.

SALEM, ORE.—To apply the "common user" principle to the wires of the Pacific and Home telephone companies in the new Oregon Hotel in Portland is the purpose of a complaint filed with the Railroad Commission by the hotel company. It is alleged that the Home company is willing for such co-operation, but the Pacific company absolutely refuses. Each telephone company has a switchboard in the hotel lobby. The complaint points out that the switchboards are located close together and that it would be practically no trouble or extra expense for the calls coming over the wires of one company to be connected up with the instruments of the other company.

OAKLAND, CAL.—While no definite action was decided on at a conference of the city council and representatives of the Pacific States Telephone & Telegraph Company plans calling upon the State Railroad Commission to fix the telephone rates for the coming fiscal year in the bay cities were discussed. John W. Gilkyson, division commercial superintendent of the company, answered all questions put by the councilmen. In answer to a suggestion from Mayor Mott that the business telephone rate be lowered, Gilkyson responded that if this were done the telephone company might install the toll system in the bay cities. This would mean that all calls between Oakland, Berkeley and Alameda and the other nearby communities would cost 6c each. At the present time there is no extra charge for intercity communication.

WATERWORKS.

MILWAUKIE, ORE.—Milwaukie voted in favor of the measure to authorize bonds to the amount of $20,000 to acquire or build a waterworks.

BOISE, IDAHO.—The city council has awarded the contract for the installation of the new lighting system to the Standard Engineering Company of Seattle. The price was fixed at $29,903.

ESCONDIDO, CAL.—The city trustees and directors of the Mutual Water Company are about to agree on a price for the water distributing system owned by the water company, which the city contemplates buying.

REDLANDS, CAL.—Work has commenced on the installation of a new water system and extensions of the old Domestic plant. The system will traverse the principal streets of the business section and residential portion of the city.

FULLERTON, CAL.—The city trustees have awarded the contract for the new city water system to John F. Blair and A. O. Stoval. The proposal of the Fullerton Domestic Water Company to sell its plant to the city at $15,000 was refused by the trustees, being considered too high.

SAN BERNARDINO, CAL.—The water system north of the base line in the northern part of the city is to be greatly improved, and residents in that section will get good water pressure. The 100 inches of water now received from Lytle creek will be diverted through a new pipe line to be built from Campbell to the present main on Highland avenue.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

March 15.

The Sacramento Natural Gas Company has applied for authority to sell $200,000 of bonds, for the purpose of liquidating existing indebtedness for construction purposes.

The Petaluma & Santa Rosa Railway Company applied for authority to issue $80,000 of bonds and $64,000 of notes, the proceeds of which will be used to construct a trolley line from Liberty to Two Rock.

Jonathan Grant Kirkman, of Cuttens, Kern County, and John Alles, of Exeter, Tulare County, joined in an application asking that the former be authorized to lease to the latter the Central Telephone Exchange at Exeter.

March 17.

A decision was rendered granting authority to the Pomona Valley Telephone & Telegraph Union to issue $100,000 of bonds. It proposes to use the proceeds to retire existing bonds and notes, and to extend and improve its system.

The Los Angeles Gas & Electric Corporation applied for authority to issue $900,000 of bonds. The proceeds will be devoted to the purchase of the Valley Gas & Fuel Company, to new equipment and extensions.

The Valley Gas & Fuel Company and the California Coke & Gas Company applied for authority to sell their systems to the Los Angeles Gas & Electric Corporation.

March 18.

Mr. George W. Kitchen filed an application for a certificate of public convenience and necessity to construct a gas plant at Madera.

L. G. Thistle, owner of a telephone company exchange at Mariposa, and the Pacific Telephone & Telegraph Company joined in an application to establish connection at Mariposa.

March 19.

A decision was rendered upon the complaint of James P. Glass, of Del Mar, who asked that the Del Mar Water, Light & Power Company be compelled to furnish service to him. The water company contended that a large outlay of money would be required to supply water to Mr. Glass, whose holdings were upon an elevation. The commission decided that the company should supply water to Mr. Glass; that the company and Mr. Glass should divide the expense of the pipe required for the extension; that the cost of making the connection from this pipe with the property of Mr. Glass should be borne by the plaintiff; and that the maintenance of the extension should be borne by the company.

March 20.

Louis Evans, who conducts a telephone business in the towns of Graham and Tranquility, Fresno County, and the Pacific Telephone & Telegraph Company joined in an application for authority to establish a connection for the interchange of business.

March 21.

The Northern Electric Railway Company applied for an order authorizing the sale of a high-tension transmission line between Nicolaus, Sutter County, and Riego, Placer County, to the Pacific Gas & Electric Company for $11,691.37, plus interest in the sum of $185.09.

The Encanto Mutual Water Company applied for authority to put into effect a rate of 25 cents per thousand gallons, with a minimum charge of $1.50 per month.

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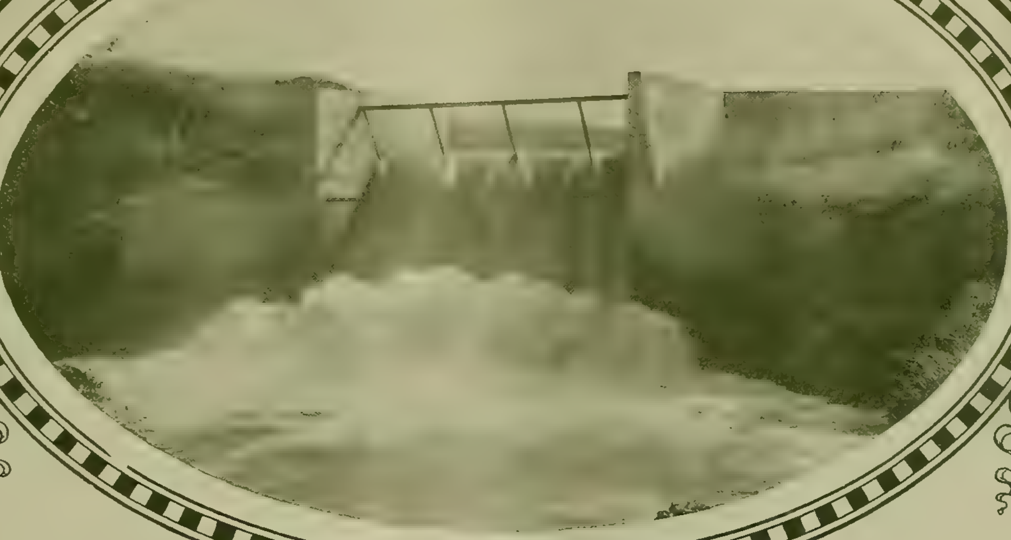
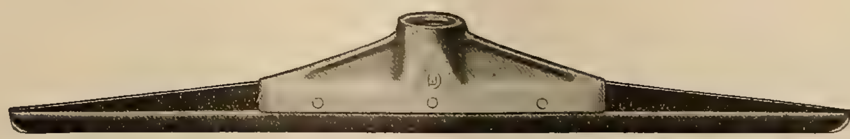


Concrete Canal Drop, Modesto Irrigation District

Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**

Opinions of Three Prominent Railway Men on O-B Extruded Ears



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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX SAN FRANCISCO, APRIL 5, 1913 NUMBER 14

ELECTRICITY IN THE CEMENT INDUSTRY

BY L. D. GILBERT.

Portland cement was discovered before Christ. The Romans used it in the construction of the Pantheon, which has for 2000 years withstood the ravages of storm and time.

Cement was a lost art for a great many years, and was re-discovered by an English engineer, who built the Eddystone lighthouse of cement in 1759, and this structure is as substantial today as when it was constructed.

A Pacific Coast Cement Plant.

It, however, remained for the Germans to take up the manufacture of cement and make it an article of commerce. This is why it is often said that Germany is the mother of the cement industry.

The development of the American cement industry during the past decade has been one of the marvels of the age.

Portland cement concrete has come to be recognized as the ideal building material for all first-class construction work, and is conceded to be the greatest advancement in building construction since the introduction of structural steel, which ranks first, with Portland cement concrete a close second. Portland cement is in addition, gradually but surely, overcoming this lead. Concrete will be used in more different forms than any other known structural material. For instance, the railroad tie of the future will be of concrete, country roadbeds of the future will be of concrete, cement pipes for drains, sewers and water lines, telephone, telegraph, electric transmission line poles, fence posts, piles, wharves, bridges, barges, lagging and props for mines, and a thousand other uses that cannot here be enumerated.

There is no limit to the future of Portland cement. It is now used in almost every building or structure that is being erected. If the structure be of steel, concrete is used for foundations, fireproofing, floors, etc. When a structure is put up of thus material, it stands for ages and is as solid as the rocks of Gibraltar.

Too much emphasis cannot be placed on the fireproof quality of concrete construction. For example, in the great conflagrations at Baltimore and San Francisco the concrete structures remained practically unharmed, when the unquenchable walls of flame swept over and destroyed all other forms of buildings. The report of the National Board of Fire Underwriters on the San Francisco disaster shows that less than five per cent of the reinforced concrete floors were materially damaged.

The growth of the Portland cement industry has increased more than any other industry in the United States. This can be shown from the fact that for fifteen years prior to 1895 the growth of the industry

was slow though constant, and in the year 1895 the statistics of the Department of the Interior showed the output for the entire United States to be 990,324 barrels, while the estimated output for the entire United States for the year 1912 will run over 80,000,000 barrels, showing the production of 1912 to be eighty times that of 1895, this covering a period of seventeen years.

What we today understand as Portland cement is a certain compound of silica, alumina and lime in the proportions of 20 to 23 per cent of silica, 8 to 10 per cent of alumina, and 62 to 65 per cent of lime. It is not possible to obtain these ingredients in large quantities in the state of absolute purity, and we find alumina replaced by ferric oxide (or iron) and lime by magnesia, to three, and as high as four per cent, so that the cements found on the market today deviate slightly from the above analysis, without suffering greatly in their physical properties.

There are a number of other chemical compounds which harden or set when mixed with water. The importance of the use of Portland cement, commercially, as against the use of other compounds having the same properties, is because of the cheapness with which it can be manufactured, and not because of any peculiar properties not possessed by a number of other compounds. The mere mechanical mixture of silica, alumina and lime in the above proportions will not yield a Portland cement—it is essential that the ingredients be combined, and practically the only way in which such a union can be brought about is by a fusion of the mixture.

Cement Crusher Building and Locomotive Round House

Raw materials entering into the manufacture of cement are found in almost every state in the union. The raw materials that are used are marl mixed with limestone, shale mixed with limestone, clay mixed with limestone, and blast furnace slag mixed with limestone.

In the manufacture of Portland cement there are two methods commonly used, the dry process and the wet process. In the dry process the materials after coming from the quarry are crushed, mixed, dried and pulverized, ready for the kiln in the dry state, while in the wet process, the materials coming from the quarry are crushed, mixed, but in the pulverizing, water is added to the extent of 35 to 40 per cent. In order to give you an idea of the process of the manufacture of Portland cement we will take as an example a plant in which the process is wet. The materials in this process are shale and high lime, the fuel coal, the grinding machinery, ball and tube mills, and power, electricity, using induction motors.

In the quarry, which is adjacent to the plant, the limestone and shale lie side by side in a blanket vein, with a face of from forty to fifty feet in height above the quarry floor. In quarrying, a well-drill, such as is used for drilling the ordinary well, is used for drilling the blasting holes. A series of 5⅝ in. diameter holes are drilled along the face of the quarry, twenty-five to thirty feet back. These holes are then sprung and loaded with explosives. A number of holes are connected up and with the aid of a battery,

Limestone by the Trainload for Cement Manufacture in California

are shot at the same time, a single blast sometimes bringing down thirty to forty thousand tons of rock. After blasting, the rock is loaded into dump cars by the use of a steam shovel, and are hauled to the crusher by a steam locomotive.

After arriving at the crushing department the contents of the cars are dumped into a crusher and crushed so that all of the product will pass a 2½ in. ring. The material is then elevated and delivered into storage bins, the crusher doing service for both materials alternately, but the materials are stored in separate bins side by side preparatory to proportioning, or mixing. From the rock storage bins the limerock and shale are drawn out separately upon a belt conveyor which passes through a tunnel under the bins, and is conveyed to the proportioning bins, which are set side by side over a pair of automatic tandem scales. The scales are set by the chemist of the factory, to weigh out and deliver to the ball mills the proper proportions of limerock and shale. We now have in the bins over the ball mills what is termed the "mix." The "mix" is then fed into the ball mills by a mechanical feeder which is regulated to suit the capacity of the mill. At this point the water is added in the proper quantities to give the ground mix 35 to 40 per cent moisture, according to the physical properties of the material. The material now is reduced to a fineness that all will pass a 16 mesh sieve and is spouted direct to the tube mill. The ball mill in the grinding process, as described above, is the granulator and the tube mill is the pulverizer.

The ball mill is one of the old reliable granulators that has been used in the cement industry for years. It consists of a cylinder of about 8 ft. in diameter by about 6 ft. long, lined inside with steel plates, so as to form a series of steps. The cylinder is carried horizontally on a shaft passing through its axis, and is supported on two bearings, one end of the shaft being fitted with a large spur gear, which in turn

meshes into a small pinion, mounted on the pinion shaft. The pinion shaft is carried on three bearings and is fitted with a pulley, or an elastic coupling for belting or connecting the motor direct. The larger sizes are charged with 10,000 to 12,000 pounds of steel balls, ranging in size from three inches to five inches in diameter, the mill requiring from 100 to 125 h.p. motors to drive it at a speed of from 22 to 23 r.p.m. The material is fed into the mill through an open

Crusher Building

spider on the end of the cylinder opposite the main gear. The ground material is discharged through screened port-holes near the periphery of the shell in the side plate opposite the feed end. Ball mills have a capacity, preparing tube mill feed, of 1500 to 2000 pounds of raw material per hour, per 1000 pounds of balls in the charge, according to the physical properties of the material.

The tube mill, as before stated, is a pulverizer, and is used for fine, or to finish grinding the material from the ball mill. It consists of a cylinder about 6 ft. 6 in. in diameter by 20 ft. to 22 ft. in length, and is lined inside with silex (or flint bricks), which are 2 to 2½ in. thick, laid in cement mortor. The inside of the tube mill when lined is comparatively smooth. The mill rotates horizontally on two trunnions, supported on bearings, forming the heads or ends of the cylinder, and is driven by a gear and pinion similar to the ball mill, the material being fed through a hollow trunnion at one end, and the finished material discharging through a hollow trunnion, or through screened discharge ports in the periphery of the shell opposite the feed end. The grinding medium is flint pebbles, ranging in size from a hen egg to a goose egg. The mill is charged about half full of these pebbles. There are no screens (other than those to retain the pebbles) used on this machine, the fineness of the material being governed by the fineness and quantity of the material fed to the mill—the greater the quantity of material fed to the mill the coarser the product and vice versa. It will take a motor of from 150 to 175 h.p. to drive a mill of this size at a speed of 22 r.p.m.

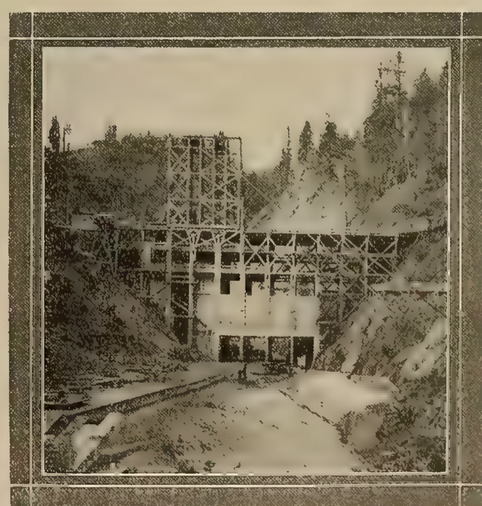
The "mix" now, after passing through the ball and tube mill and ground to a fineness such that about 90 per cent will pass a 200 mesh sieve and of the consistency of thick cream (called slurry), is pumped by compressed air to the slurry tanks in the kiln building.

The kiln in which the fusion (or burning) is done is a cylinder 9 ft. in diameter by 200 ft. in length, and is built of heavy steel plates riveted together, and is carried on steel tires rolling on steel rollers. Near the center of the kiln is a train of gears, the pinion of which meshes into a girth gear, bolted to the kiln shell. The kiln is set on a pitch of ½ in. per foot, pitching toward the firing end. The kiln is lined with high quality special fire brick which have a thickness of 9 in., 6 in., and 4 in. respectively, beginning at the firing end. The total weight of the kiln, as described, is about 500 tons, and is driven by a 50 h.p. variable speed motor, having a speed ratio of 3 to 1. The motor is controlled from the burning floor and rotates the kiln at a speed of from ¼ to ¾ r.p.m.

The burning of the material in the kiln is done by the use of powdered coal, which is ground to a fineness such that 85 to 90 per cent will pass a 200 mesh sieve. This is blown into the kiln by a low pressure air blast, creating a temperature in the clinkering zone of from 2500 to 3000 degrees Fahrenheit, which, after passing the length of the kiln is reduced to from 450 to 500 degrees, escaping through a large stack.

The slurry is drawn from the slurry tanks and pumped to an automatic feeder and is fed into the kiln at the stack end. The moisture and carbonic acid are driven off by the heat, and clinker is formed as the mixture gradually travels through the kiln. The clinker at a temperature of from 1500 to 2000 degrees Fahrenheit is discharged directly into a cooler where it comes in contact with a current of air and is cooled sufficient for handling.

The cooler is a steel cylinder carried on steel tires and rollers similar to the kiln but smaller, being only about 6 ft. in diameter by 60 ft. in length, and

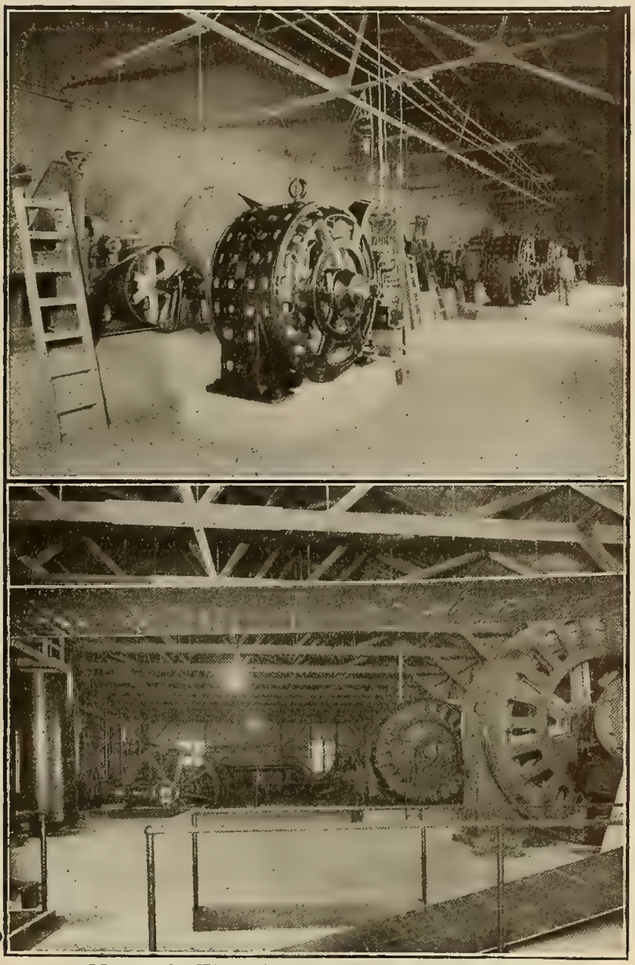


Rock Bins at the Quarry

is set on a pitch of ¾ in. per foot and is motor driven at a speed of about 3 r.p.m. by a 20 h.p. motor. A low pressure fan connected to the discharge end supplies the air for cooling.

The clinker, coming from the cooler, is conveyed to the clinker storage bins. It is then drawn from the clinker bins and delivered to the cement grinding department where about 2 per cent of gypsum is added. This is done in order to govern the setting time of the finished cement. It is then delivered into a bin over the clinker ball mills similar to the ball

mills in the raw grinding departments. The granulated clinker coming from the ball mills (all of which will pass a 16 mesh sieve) is delivered to the cement tube mill bins. These latter two mills are motor driven and are practically a duplicate of the mills in the raw-grinding department. In the cement-grinding department the clinker is ground in the dry state. The finished cement is then delivered to the stock house and thence to the packing department, where it is automatically weighed into the sacks, each sack holding 95 pounds and taking four sacks to make a barrel, the unit upon which all costs, output, etc., at the factory, are based.



Motors in Finishing Mill of a Cement Plant.
Motors and Compressors.

Electricity has been a very important factor in the development of the cement industry. The old two-kiln cement factory, with a capacity of from 250 to 300 barrels per day of 24 hours, was shaft-driven, the engine being belted to the line shaft. A small engine-driven d.c. generator set was generally installed for the use of lights only. All the crushing, granulating, and pulverizing machinery was located adjacent to the line shaft which passed through the engine-room walls on either side, causing the engine-room to be located in the center of the plant, where it was impossible to exclude the dust, obtain light, or get ventilation. As cement plants operate 24 hours per day and seven days per week, a continuous operation becomes a vital factor. It is therefore no wonder that in the old belt-driven plants the maintenance was high and the efficiency and load-factor low. Every machine was belted to the line shaft which as a rule was equipped with a great number of friction clutches, that with their complication of levers and springs, when filled up with cement dust, did not help matters any, in fact, even gave a great deal of trouble and caused numerous shut-downs of the entire plant, it being necessary to shut down the entire plant to do any repair work on the shaft, clutches, or belts.

In the later designed plants, electricity became more in evidence. The major portion of the power was delivered to the mills by line shafts. Some of the small power consuming departments, such as the crushing department, coal grinding department, packing department, and generally an auxiliary drive for the kiln department, were motor driven. As a rule these motors were all direct current and required a great deal of care and attention. They did not operate very satisfactorily in the cement dust, and when they were enclosed it was almost impossible to get good ventilation, consequently the burn outs were numerous.

The cement industry was growing rapidly—far more rapidly than the most optimistic cement companies had anticipated. The orders came in faster than they could be filled, and it became necessary to increase the plant output. Plants that had been running less than a year decided to double their capacity. Most of these had been designed without any provision for increasing their capacity. The line shafts were full of pulleys and the engines were overloaded. The problem then confronted the operators as to how they could increase, without remodelling the old plant from end to end or build a new one.

The electric motor solved the problem. It was a simple matter to install more boilers and engine driven generators. If there were no room in the old power house, a new one could be erected. Crushers, mills and kilns could then be added without any regard to their relation to the old line shaft.

A great many plants that were increased used a short line shaft driven by a large motor, from which three or more mills were driven as a battery, but the individual motor drive proved, however, the more satisfactory and efficient. With the individual motor drive, and with fairly large bins over the mills, in the various stages of the manufacture, units could be shut down for the necessary slight repairs independently of one another, and in this way gave a chance to make that proverbial "stitch in time" and thus keep down the maintenance cost. This increased the load factor with a corresponding increase in the output.

Later plants were designed with motor drive throughout. Some of them stuck to the group driving of machines, while a few put in individual drives. Direct current was used exclusively, and although in plants of this type, the plant efficiency was greater than the old line shaft driven plant, or the combination line shaft and motor driven plant, yet the installation was quite short of the ideal. The direct current motors were not hardy or fool-proof enough, to stand up to the severe service and abuse they were subjected to. Burn outs were numerous and a great deal of trouble was experienced with the commutators and brushes, caused by the dust, heavy load and continuous service.

Before 1900 the use of electric motors to any great extent was practically unknown in the cement industry, but in less than six years they were introduced extensively in both old and new plants, and there were comparatively few plants that did not use electric motors on at least part of their equipment.

It remained however, for the induction motor to make the motor drive ideal. No commutator, no brushes, no rubbing parts, a machine that would stand all kinds of abuse—one that was practically fool-proof, one that could be cleaned off with a scoop shovel and dressed down with a cement sack, and with its dust tight bearings seemed to run just as good in the dust as it would under ideal conditions.

One of the first plants built to install induction motors making an ideal installation was the Union Portland Cement Company's plant at Devil's Slide, Utah, which was erected in 1906. Individual induction motor drives were installed throughout. Practically all of the motors were slow speed and were direct connected through the medium of an elastic coupling, to the pinion shafts of the crushers, ball mills, and tube mills. The elevators, conveyors and all small machines, were driven through the medium of cut gearing. The heavy drives were the ball mills which were driven by 50 h.p. motors, running at a speed of 168 r.p.m. and the tube mills being driven by 120 h.p. motors at 153 r.p.m. Although there were a great many predictions that these motors would never start the load (as mills required 175 per cent starting torque) yet no trouble was experienced, although no starting compensators were used. Each motor had its own starting panel, upon which was mounted one ammeter, one oil circuit breaker, with overload trip coil, and one three-pole, single-throw spade handle knife switch of proper capacity. In starting, the trip on the circuit breaker was held with one hand, and the knife switch thrown in with the other. When starting motors of this size, with mills fully loaded (taking not less than 175 per cent starting torque) and with full line voltage, there was of course a heavy pull on the line, which being only momentary, was taken care of very nicely by the turbines in the power house, and was scarcely noticeable.

In this plant which had a capacity of 2000 barrels of finished cement per day, there were four kominuters and five tube mills in the raw grinding department. One kominuter and two tube mills in the coal grinding department, and four kominuters and six tube mills in the cement-grinding department (a kominuter being a granulator very similar to a ball mill). If, for any cause the entire plant was shut down, care was taken in starting up, so that a number of these motors were not thrown on the line at the same time. For instance, the motors in the raw grinding department would be started first. After all the conveyor and elevator motors were started, the motor tender would start the large ones, one at a time, as fast as he could walk from one to another, the mills being set sixteen feet on centers. The cement grinding department would then be started in a similar manner—then the coal grinding department, and so on, and the entire plant could be gotten under headway in a few minutes. This installation proved very satisfactory and demonstrated the ability of the induction motor to start and drive fully loaded machines, without the necessity of friction clutches, and which required close to 150 to 175 per cent starting torque.

In the last five years in the neighborhood of twenty new cement plants have been built, representing close to 50,000 electrical h.p., and all but a very small proportion have used induction motor while the small proportion have used induction motor drives throughout, while the remainder used motors for their shaft drive on their main grinding units.

The quantity of Portland cement produced in 1911 was about 78,000,000 barrels. Estimating the production for 1912 to be 80,000,000 barrels, and that this amount is produced by plants running at 70 per cent of their full capacity for the entire year, we would have a production of 313,000 barrels per day of twenty-four hours in round figures. Assuming that 70 per cent of the power consumed in producing this 80,000,000 barrels of cement is furnished by electric motors, we would have an equivalent of 219,100 barrels for the motor's share of the daily production.

The power consumption of a plant depends a great deal upon the process, whether wet or dry—the type of grinding mills—the fineness of the finished product—and the character of the raw material. But to assume that 1½ motor horsepower is installed for each barrel of finished cement that is produced in a plant in 24 hours, and assuming 18 kw. hours for each barrel of finished cement produced, and a 72 per cent power factor, all of which are a fair average, we would have 328,650 h.p. stamped on the name plates of the motors, with the indicating wattmeters on the switchboards hovering around 245,500 kw. and about 340,000 k.v.a. on the generator.

In conclusion, these facts will prove the value to this industry that the induction motor has proven. Naturally, in a field of such vast extent there bave become many contributors and competition made more keen by so many producers. Competition has, too, necessitated the constant reducing of the cost of production. The extent of the use of this material in the future is merely a matter of familiarity by the manufacturer, the architect, the engineer, and even the farmer, to its use, and this familiarity is being gradually brought about by the lowering of the cost of production.

The electric motor has been a prime factor in reducing this and has helped to make it possible to put this most valuable building material on the market at a price that will allow its use in substitution of practically all other building materials.

[The foregoing paper was read before the Portland Section of the American Institute of Electrical Engineers on December 17, 1912.]

NEW FRENCH ELECTRIC STEEL PLANT.

It is reported that the well-known French armament company Schneider, Creusot, along with the steel company the Societe des Hauts Fourneaux et Forges d'Allevard, are about to erect a large plant in Pontcharra (Isere Department) for the electrolytic production of steel. It is stated that the electric furnaces employed will be among the largest yet laid down. It is intended to erect a hydroelectric station for the generation of power.

ELECTRICAL PUMPING AND IRRIGATION

FALLS IN CANALS.

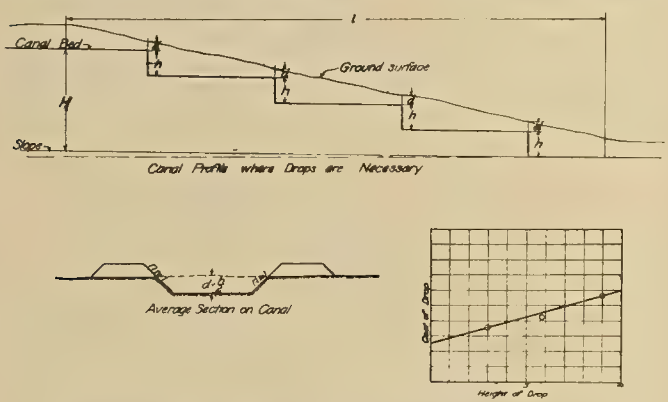
BY B. A. ETCHEVERRY.

Excessive slope.

When possible it is always desirable to select for the grade of the canal the actual slope of the country. It often happens that the actual slope of the country is so great that this would give a velocity which would cause erosion. To prevent this it is necessary to use a grade which will give the proper velocity and to concentrate the excess fall at suitable points along the canal by means of falls or rapids.

Location of falls.

The proper location must be near the place where the canal bed if continued without drop would have to be carried in embankment. A fall should not be built entirely in embankment for the dangers of breaks are too great. When the surface slope is not uniform, falls or chutes will generally be placed at those points where there is an abrupt drop. When the surface slope is uniform they will be spaced about equal distances apart and will be of about the same height. The choice will be between high drops spaced far apart and a greater number of low drops spaced close together. High drops spaced far apart will give a greater amount of earthwork in the canal excavation, but the total cost of drops may be less as shown in the accompanying sketch. In any case of uniform slope there is an economic height of drop which will give the minimum total cost of drops and canal excavation. This is determined as follows:



Diagrams Illustrating the Determination of the Economic Height of Drops.

Economic height of drops for a uniform ground slope.

Let v = minimum depth of cut.
b = bottom width of canal.
$n : 1$ = side slope of canal.
A = area of cross section.
h = height of one drop.
l = total length of canal considered.
H = total excess fall in length l.
n = number of drops in length l.
V = total volume of excavation.
C_1 = cost of those parts of a drop which are common to drops of any height such as wings, floor, etc.
K = constant depending on type of drop.
C_2 = cost of a single drop.
C_3 = total cost of drops in length l.
C_e = cost of excavation per unit volume.
C_4 = total cost of excavation.
C = total cost of drops and excavation.

To determine C_1 and K the type of drop must be decided and the cost of drops of various heights must be estimated. These costs with the corresponding heights must be plotted. The curve joining the points will give a straight line. The intersection of this line with the cost axis will give C_1 and the slope of the line will give K. This is shown in the plot given below. The relations between the different elements are:

$$C_2 = C_1 + Kh$$
$$n = H/h$$
$$C_3 = \frac{H}{h}(C_1 + Kh) = \frac{C_1H}{h} + KH$$
$$A = (d + h/2)\ [b + n(d + h/2)]$$
$$V = lA = l(d + h/2)\ [b + n(d + h/2)]$$
$$C_4 = VC_e = lC_e(d + h/2)\ [b + n(d + h/2)]$$
$$C = C_3 + C_4 =$$
$$= \frac{C_1H}{h} + KH + lC_e(d + h/2)\ [b + d(d + \frac{h}{2})]$$
$$C = \frac{C_1H}{h} + KH + lC_e\left[bd + \frac{bh}{2} + n(d + \frac{h}{2})^2\right]$$

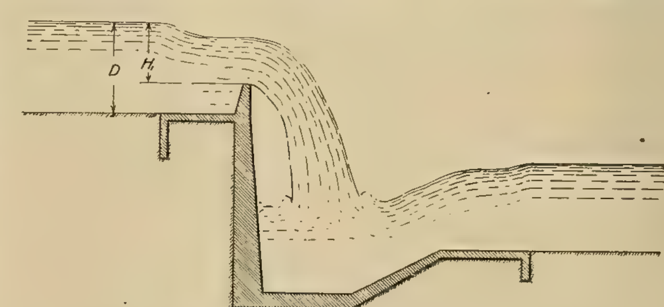
To obtain minimum cost.

$$\frac{dC}{dh} = \frac{C_1H}{h^2} + lC_e\left[\frac{b}{2} + \frac{2n}{2}(d + h/2)\right] = 0$$
$$\text{or } h^3 + (2d + \frac{b}{n})\ h^2 - \frac{2C_1H}{nlC_e} = 0$$

The effects of falls on flow of water in the canal, are:

1. An increased velocity upstream.
2. Impact and erosion of falling water downstream.
3. Erosion caused by eddies on downstream side.

1. Increased velocity upstream. This is due to two causes: a drop in the water surface at the crest, and a gradual drop in the water surface extending a considerable distance upstream. In the first case the water drops as it passes over the breast wall of the drop and the depth of water on the crest of the wall will be about 2/3 of the depth of water measured a short distance above the crest. This action is not objectionable for it only extends a few feet upstream. It cannot be prevented but may be resisted by a short floor on the upstream side. The second effect will not occur if the discharge over the drop and the carrying capacity of the canal are made equal when the



Raised Crest of Breast Wall of Drop to Prevent Increase in Velocity Up-Stream.

level of the surface of the water is kept the same at the drop as in the canal above it. This may be obtained by three methods.

(a) Use the same depths of water over the crest of the breast wall as the depth of water in the canal and compute the length of breast wall which will give equal capacities.

Let l = length of crest.
D = depth of water in canal.
Q = carrying capacity of canal for depth H.
v = velocity of approach.
m = a constant for discharge over weirs.

$$Q = ml\left(D + \frac{v^2}{2g}\right)^{3/2} \quad \text{Capacity over breast wall.}$$

$$l = \frac{Q}{m\left(D + \frac{v^2}{2g}\right)^{3/2}}$$

The disadvantages of this method are: (1) the length of crest corresponds to the depth of water in the canal for which it was computed and only works perfectly for that depth. (2) This method requires that the width of the canal be contracted to the length of the crest. The effect of this contraction on the downstream side is to increase the erosion caused by eddies which always occur when passing from a smaller section to a larger one, or from a higher velocity to a lower one.

(b) Use a length of breast wall greater than obtained by above equation and raise the crest of the wall to a height which will maintain the upstream water level at its normal height. The width of the breast wall is generally made equal to the average width of the canal. The height of water passing over the crest of the breast wall is obtained by the equation $H_1 = \left(\frac{Q}{ml}\right)^{2/3} - \frac{v^2}{2g}$. If D = depth of water in canal, then the crest must be raised above the bed of the canal upstream a height of $h = D - H_1$. The objections to this method are: (1) The height of the raised crest is correct only for the carrying capacity for which it is computed. This can, however, be remedied by using flashboards to regulate it for other depths. (2) It increases the height of fall. This however, is not serious. A third objection which is sometimes made is that it requires a longer breast wall than obtained by the first method. This, however, may be more than balanced by the smaller length of wing walls. The advantage of this method is that it reduces erosion by eddies on the downstream side. This makes this form more desirable than the first one.

(c) Use a notched raised crest. This is obtained by extending the breast wall above the canal bed up to full supply level and dividing it into a number of trapezoidal notches so designed that for any carrying capacity the depth of water in the canal and the depth at the notch are equal. The theoretically correct form requires curved sides but in practice a trapezoidal notch is sufficiently accurate. To design the notched wall it is first necessary to determine the length between abutments, the number of notches, and the dimensions of the trapezoidal opening. The following empirical rules are recommended in India:

1. Make the total length of breast wall between side walls equal to from 1 to ⅞ times the average width of the canal.

2. The number of notches depends on the top width of notches and the length of the crest of the piers separating them.

3. The top width of notches should not exceed the depth of water in the canal and may vary from ¾ to 1 times the depth.

4. The top length of crest of piers should not be less than ½ the depth.

5. The distance between notches center to center is about 1½ times the depth.

To determine the bottom width and side slopes of the trapezoidal notch it is necessary to obtain the formula for the flow through a notch drop in terms of the bottom width and the side slopes and solve

Series of Drops on Comanche Canal, Colorado.

for these quantities by applying the formula to two special cases for which the discharges and the corresponding depth of water in the canal are known. The carrying capacity should be selected to represent the usual conditions of flow in the canal and the corresponding depths are obtained by means of Kutter's formula. The formula for flow through a notch, neglecting the velocity of approach and the solution for base width and side slopes of notched openings are obtained with aid of the calculus:

Let b = bottom width of notch.
n : 1 = side slopes of notch.
H = depth of water.
H_1 and H_2 = depth of water for special cases corresponding to Q_1 and Q_2.

The dimensions of the notched openings are obtained from the above formula. The trapezoidal piers separating the openings are designed as cantilever walls. The edges of the piers are tapered or rounded as indicated below and at the foot of the notch on the downstream side a semi-circular lip or shelf projects horizontally. The object of this lip is to discharge the water in a fan like shape and decrease the erosive power of the water.

The above three methods will prevent only one cause of the increased upstream velocity; the other cause due to the curve of depression at the crest of the fall only extends a few feet and can be resisted by an upstream floor or paving extending a short distance upstream from the crest. In many cases no protection is used.

READINESS TO SERVE METHODS

THE INVESTIGATION BUREAU.

BY ROSS B. MATEER.

To possibly no cause, other than the haphazard manner in which current consuming apparatus is marketed and installed for industrial and agricultural purposes, can the complaints of poor service, so numerous with some quasi-public utilities, be traced. Ninety out of every hundred claims of high bills are not a fault of the central station, but directly due to the equipment and its operating characteristics. The motor equipment in the factory may be arranged for group drive, yet a careful investigation results in a plan of individual motor drive possessing increased over-all efficiency and reflected in decreased monthly current consumption.

The fluctuations in voltage, with subsequent speed variation, reduce the output of finished product in the mill and the overloading of a motor continuously in excess of the 25 per cent limit results in damaged apparatus. While in the first instance it is obviously up to the power company to improve the service, is it not, too, the part of wisdom to inspect the motor equipment when a utility is anxious to provide service?

An agriculturist, confident of the profits accruing by intensive cultivation of his soil and possible with irrigation facilities, interviews machinery supply houses, purchases a pump and motor, which is shipped to its destination, there to be installed by the "help" around the ranch. Excessive power bills are noted, the quantity of water delivered to the soil is not equal to expectations and naturally the power company is criticized. Misunderstandings of this character are general where the right pump and motor are not selected and properly installed. An appeal to the power company usually results in either additional transformer capacity for the installation or in referring the consumer to the supply houses for relief, which, if not obtained, retards the general growth of electric service.

How best to handle complaints of the character mentioned and others arising by reason of a just or fancied grievance, is a problem to many central stations, each of which is desirous of popularizing electricity. Some refer complaints on bills to those who re-read the meter, and if checked, promptly pass the bill for collection. Complaints on voltage are followed by a voltmeter reading at or near the time the service is declared poor. Few have attempted to supervise the operation of an industrial installation, though a general inspection of all apparatus, with reference to efficiency and service would be welcomed by the owner and operator.

It does not seem that the interest of the utility should end with the delivery of current at one point, irrespective of the service rendered, when confidence in electrical apparatus and its general use is to be encouraged at the expense of the reputation of a utility with quantities of its product to market.

Again, campaigns may be successfully launched for the general introduction of a particular applianace, but is it not equally important to continue in service those current-consuming devices now on the lines and which in many ways are misunderstood, not alone as to operating costs, but as to characteristics, load factor and power factor?

Consider, if you please, the varying phases of investigations, such as: Checking meters as to accuracy; supervision of line regulation; securing of charts on commercial, residential and power feeders; determination of load factor for each industrial and agricultural installation; the demand, maximum and average, occasioned by various industries; the revenue per horsepower demand with reference to locality. All of these are now functions of many departments of a utility, each striving to obtain such data as pertains to its own welfare at often a high cost. Would it not be infinitely better to establish and maintain a bureau of investigation and include as functions of the department, all phases of operation, and service, as pertain to the satisfactory solution of problems affecting the operation and cost of apparatus, wherein the power company and the public are mutually interested? The investigation bureau would thus constitute itself an arbitrator where needed. As to the personel of such a bureau, it should be under the absolute direction of a competent engineer, thoroughly conversant with commercial methods and cognizant of operating and accounting.

Included and assisting this bureau should be an industrial engineer, and one or more cadets, graduates of a university or technical institution. An organization as outlined, encouraging confidence, "does not pass the buck," eliminates competitive power, other than electrical, and stimulates the general use of electrical apparatus by its zeal for a square deal alike to utility and consumer.

PLAN ELECTRIC SYSTEM FOR THE PHILIPPINES.

To join all the towns of Albay Province in a network of wires conveying electric current for lighting and domestic purposes is the work planned by a number of Filipino capitalists of that Province, headed by the wealthy Imperial family.

The work, including the erection of power house, transformers, and wire installation, will begin as soon as a franchise has been secured from the government, and negotiations are already under way for the purchase of motors, dynamos, and other necessary machinery and material.

The power house will be located at a convenient point near a stream between Guinabatan and Camalig, and current will be conveyed by means of transformers to Legaspi, Albay, Daraga, Camalig, Guinabatan, and Ligao. As soon as these towns have been connected, it is the intention of the company to extend the line to the coast towns, including Tabaco, Malilipot, Bacacay, and Libog.

THE BERRY IMPULSE TURBINE.

BY S. L. BERRY.[1]

In making a commercial comparison of the Francis turbine, the Berry impulse turbine and the single jet impulse water wheel, it is considered unnecessary to go into the details of what is known as the "type characteristic" method of comparing various kinds of water wheels. It is generally accepted and has been used recently in an experimental determination of the best design for the largest turbines built to date. The system takes the form of a certain range of numbers within which a particular type of wheel is best adapted. For the single jet impulse water wheel this range is from 0 to about 4. The upper limit is not defined with exactness because varying conditions change the limit, but it is known that above 4 the efficiency falls off. The range for the Francis turbine is from 12 to 87, which has been divided into three or more parts, each suitable for a particular form of this turbine. The figures are those worked out by Zowski as giving generally acceptable limits.

It is seen that there is a gap between the upper impulse and lower Francis limits. This has been filled in various ways, by forcing the limits of both wheels until low efficiencies and other disadvantages have been met, by the use of multiple jets, multiple impulse wheels and a combination of the latter. None of these have been satisfactory from the standpoint of efficiency and cost.

The following example will show the extent of the gap:

Head 300 feet.

200 r.p.m.	Maximum power, single jet impulse wheel.	625 h.p.
	Minimum power, Francis turbine.........	5625 h.p.
300 r.p.m.	Maximum power, impulse wheel..........	280 h.p.
	Minimum power, Francis turbine.........	2520 h.p.
400 r.p.m.	Maximum power, impulse wheel..........	158 h.p.
	Minimum power, Francis turbine.........	1420 h.p.

In each case the minimum power which can be efficiently developed by the Francis turbine under the same head and at the same speed is nine times the maximum of the single jet impulse wheel. The new impulse turbine, which has a range from 0 to about 16, covers the entire range of the impulse wheel, the gap between the two and overlaps the Francis minimum limit. The maximum powers in the above cases for the impulse turbine are 10,200, 4580 and 2580 h.p.

The extent of this gap, for a head of 300 ft., is shown graphically in Fig. 1, in which curve 1 gives the maximum power of a single jet impulse wheel at various speeds, curve 2 the minimum for the Francis turbine and curve 3 the maximum for the Berry turbine. The vertical distances between curves one and two give the horsepower relations between the wheels represented, at the given speeds, and the space between the curves gives the general conditions of the gap mentioned.

The above comparison, as far as the Francis turbine is concerned, applies to heads up to 500 or 600 ft., as engineers have been very reluctant to use it under higher heads.

The number of jets which would be required to reach the minimum Francis limit may be calculated from the characteristics 4 and 12 as follows:

$\left(\frac{12}{4}\right)^2 = 9$, or nine jets, on one or more wheels, are necessary to close the gap. A similar calculation for the impulse turbine, $\left(\frac{16}{4}\right)^2 = 16$, shows that it has the capacity of sixteen jets at any given speed. This can be reached with stream widths 37 per cent of those on corresponding impulse wheels, resulting in materially smaller buckets and lighter wheels.

The impulse turbine is similar to the impulse water wheel in that it is a free running wheel, without running water joints such as are found in the Francis and other turbines of the pressure type. It differs in that it has been designed so that it will receive water around the entire or any part of the circumference. It is therefore, not limited as to the head under which it can be operated, and while it will cover a field not heretofore covered satisfactorily, its greatest application will be found under those heads too high for the use of the Francis and other turbines of the pressure type, where, by reason of its ability to develop a given power at a much higher speed than would be possible with the impulse wheel, the cost of generators will be greatly reduced and freight and handling charges lowered.

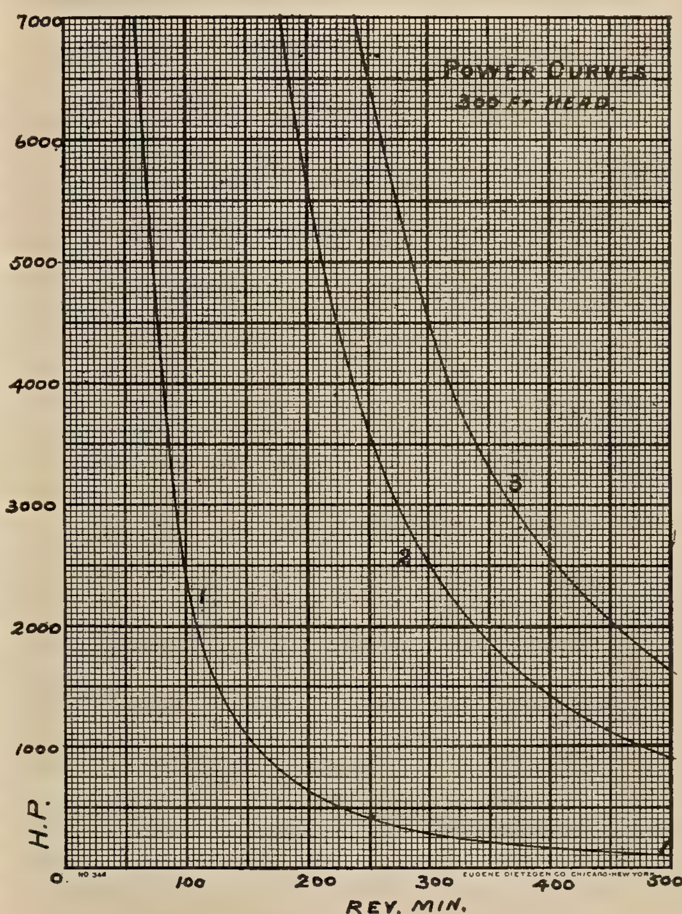


Fig. 1. Power Curves for 300 Ft. Head.

As speed is one of the controlling features in the cost of generators, it follows that the wheel which

[1] Consulting Hydraulic Engineer, Rialto Bldg, San Francisco.

will have the greatest speed for a given power and head, other things being equal, is the one which is commercially desirable. The impulse turbine, under these conditions, can be made so much smaller that it will make four times as many revolutions per minute as the single jet impulse wheel, and three times as many as the double wheel unit.

From a curve of approximate costs of 5000 k.v.a generators an example may be taken. Under a head of 620 ft. a double impulse unit would have a speed of 214 r.p.m. and the impulse turbine 600 r.p.m.

Speed.	Cost of Generator.	Frt. at 1½c.
214 r.p.m	$24,000.00	$3,000.00
600 r.p.m	15,000.00	1,575.00
	$ 9,000.00	$1,425.00

Giving a difference in cost of generator delivered at a terminal point on the coast of $10,425 to which would be added the difference in hauling and handling charges. There is to be added also the excess cost of a double unit with two housings, wheels, nozzles, gates, and the branch pipes.

For 10,000 k.v.a. units the figures are about as follows:

Head 1250 feet.

Speed.	Cost of Generator.
300 r.p.m.	$46,000.00
60 r.p.m	35,000.00
	11,000.00
Freight difference	2,000.00
	$13,000.00

Head 870 feet.

Speed.	Cost of Generator.
200 r.p.m.	$50,000.00
600 r.p.m.	35,000.00
	$15,000.00
plus frt. diff.	$17,500.00

Comparing the impulse turbine with the Francis in the field in which both may be used, it is found that the latter has running water joints around the outer circumference, that it must be balanced against end thrust, and that there are from 40 to 60 parts, inside of the machine, which move when the governor operates, while the former has no such joints, is self-balancing endwise and has 5 moving parts in the machine concerned with governor action. The greater simplicity make it a cheaper machine to construct and more durable in operation.

It is well known that the impulse wheel has a flatter efficiency curve than the Francis turbine, making it more efficient under part loads, and giving a marked improvement in what has been called the "all day efficiency." This advantage is equally possessed by the impulse turbine.

Emphasis may be placed upon a few of the points mentioned in patent No. 1,012,799, Dec. 26, 1911.

First, the limitations of the impulse wheel, as at present constructed, are well known. If more than one jet is used, they must be so separated that a bucket has discharged the water from one jet before it receives that from the succeeding one. Cases have been known where the second jet actually reduced the power of the wheel. This is an extreme case, seldom met with, but it shows tht danger of jet interference. Many cases have been found where the efficiency of the wheel falls off when the second jet is in use. While it is entirely feasible to use two or more jets, the wide separation required to retain good efficiency makes the construction unwieldy.

Second, when a vertical jet of water strikes a horizontal plate, there will be an equal spreading of the water in all directions. If the jet be inclined, the flow on the acute angle side diminishes, while that on the opposite side increases and the stream lines on the other two sides will be similar. If the plate be tipped up on one of the latter sides the water will crowd to the opposite side. It follows from the above that to produce the least deflection of a jet from the desired path, the transverse plane of the plate should be at right angles to the flow line.

Third, in a moving plate it is necessary to consider the relative flow line of the jet, which results from the relation of the direction and velocity of the circumference of the wheel and the jet. The relative flow lines of all impulse water wheels, as they have been constructed, are tangential to a larger or smaller circle, depending principally upon the relation of pitch and outside diameters. It is this condition which increases the danger of interference, and makes it necessary to widely separate the jets. As this circle of tangents decreases, so does the danger of interference within the zone of action of the jet, decrease, until the limit is reached when the relative flow lines are radial. At this point, considering a wheel with water applied around the entire circumference, all the water, relative to the moving wheel, is flowing radially, and has a minimum interference. With the pitch line of the wheel running at half the velocity of the water, this condition is found when the pitch diameter is about 0.7 of the outside diameter.

There are three types of regulating gates applicable to this turbine, first the one described in patent No. 1,025,240, May 7, 1912, which is a ring cut-off giving a contracting stream; second, a set of two rings reducing the water supply by closing in the side walls of the nozzle; third, a modification of the first. In all of these constructions it is possible to place the nozzle very close to the wheel, thereby maintaining control of the water up to the instant of its utilization. The method of control consists of two threaded rings, with gear teeth, and three pinion shafts, chain connected outside of the housing. There are five moving gate parts within the housing, all covered on their working faces and lubricated from without. Outside of the rings are placed packing rings, to which oil may be forced, and which can be washed out with water under pressure when desired. As these rings have a long circumferential to a short axial movement, the action should be smooth and easy.

It is evident that this turbine does not need to develop more than the ordinary range of efficiencies to find a wide application in the development of large water powers.

WATER POWERS IN NORTHERN CANADA.

Hydroelectric engineers in the employ of the federal commission of conservation, who have been gauging streams and examining possible water power in the Athabasca, Peace River and Slave Lake regions, the last two summers, say in a preliminary report that several million horsepower is available for development purposes. Two of the rapids in the north country are described as follows:

The Cassette, Mountain, Pelican and Drowned rapids, collectively known as the Fort Smith rapids, are situated on the Slave River and extend from Smith Landing to Fort Smith, 16 miles. This point being about 450 miles north from Edmonton and just inside the boundary of the province of Alberta. The various rapids, whose descents, taken separately, vary from 10 to 38 ft., may be considered as a continuous rapid from head to foot, broken by short intervals of swift water, giving a total descent of some 135 ft. in 16 miles.

It would probably be difficult to group all these rapids into one development, although it would be very desirable to do so from the standpoint of conservation, but the numerous islands and projecting points from the mainland afford natural conditions for easy development.

The volume of water in these rapids is enormous, being the combined flow of the Peace and Athabasca and their tributaries, with one of the great northern lakes, Lake Athabasca, acting as a reservoir to regulate the flow. The total power available during the season of navigation (May to November) by utilizing the total head of 135 ft., is estimated at 1,000,000 horsepower, and is divided among the different rapids in proportion to the head of each. Raw material for pulp and lumber industries is found all along the river and at the rapids.

The Peace River canyon has long been renowned for the wild character of its waters and no white man or Indian, be he ever so experienced in river work or urged by foolhardiness, ever attempts to run its rapids.

Rafts or boats, which, by carelessness or otherwise, are allowed to drift past its upper gates, are never seen again, being engulfed by some of its many powerful whirlpools. It is little wonder that the velocity of its waters should be so great when one considers, as has recently been ascertained, that the descent from head to foot is some 225 ft. in a distance of less than 18 miles. This immediately suggests its possibilities as a water power development.

The total minimum power available during the open water season (May to November), is estimated at 400,000 horsepower. This is based on the assumption that the total head of 225 ft. can be utilized. Its development for water power purposes will involve rather intricate problems, but to compensate for this, one must consider its situation near the raw material for pulp and lumber industries.

It is also at the head of navigation on the Peace River and lying adjacent to it are immense coal fields, large portions of which have already been staked out.

MINE GAS IGNITION BY LAMP FILAMENTS.

The Ignition of Mine Gases by the Filaments of Incandescent Lamps, is the title of Bulletin No. 52, which has just been issued by the United States Bureau of Mines. The authors, H. H. Clark and L. C. Ilsley, make the following general statement:

"As part of its investigations of the causes of mine accidents and of the safest and most efficient methods of handling electricity underground, the Bureau of Mines undertook a study of the ignition of mine gases by the filaments of electric incandescent lamps. This bulletin describes the investigation in detail, and gives a complete record of the results obtained.

"The investigation was undertaken for the purpose of determining the degree of danger that attends the use of certain specific sizes of incandescent lamps in atmospheres containing inflammable gas. Previous investigators have, to a greater or less extent, been concerned with certain theoretical features of the problem, such as the effect of the temperature and the dimensions of the lamp filaments, and the question whether a lamp may ignite gas by the heat of its glowing filament or by the spark that is drawn when the filament is broken. Although these features were considered in the present investigation and are briefly discussed in this bulletin, the principal object of the tests was to determine what sizes of incandescent lamps suitable for mine use would ignite explosive mixtures of mine gas and air, and what were the circumstances most effective in causing such ignition.

"The results of the investigation may be generally summarized as follows:

"The naked carbon filaments of standard lamps, burning at rated voltage, will invariably ignite explosive gaseous mixtures.

"If gas can reach the filaments of standard lamps without breaking the filaments or producing partial combustion within the bulbs, the explosive gaseous mixture is sure to be ignited.

"Several sizes of both standard and miniature lamps, when smashed while burning at rated voltage, will ignite gas.

"Standard lamps that do not usually ignite explosive gaseous mixtures may do so if the broken pieces of the filament cause a short circuit when the lamps are smashed."

A CENSUS OF UNDERGROUND CIRCUITS.

A movement that merits the hearty support of all is the census of underground circuits now being undertaken by G. M. Gest of New York, at his own expense.

It is planned to make a census of the underground conduits in the United States and Canada, as suggested by T. A. Martin, secretary of the National Electric Light Association.

There never has been taken a census of conduits, therefore there is no available data on hand as to how much conduit there is under the ground in the various cities and states, and because of the fact that this is so important a question, and is being agitated, more and more, from year to year, this data will be valuable.

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
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CONTENTS

Electrical Training Aboard Battleships

Editorial comment was made in our issue of March 15th relative to apprenticeship systems for utility service. It would seem that the United States navy is proposing to give opportunities to young men which will prove of interest to embryo engineers of the coast. According to the draft, the U. S. Navy in cooperation with the presidents of the universities and colleges of the United States will train a limited number of students on board battleships. This training period will be of two months' duration and not more than twenty students will be assigned to one vessel. Training which will be given in engineering, electrical, gunnery, navigation and boat departments, will be thoroughly practical and will embrace every opportunity for actual experience.

Such a proposal is in thorough accord with the apprenticeship system outlined in the editorial above referred to and it would seem that Western power companies acting along parallel lines should not hesitate longer to initiate some workable scheme of cooperation with Western universities and colleges in properly rearing competent, enthusiastic and thoroughly trained young blood for future utility service.

Electricity in the Cement Industry

The national board of fire underwriters in reporting upon the San Francisco disaster of 1906 stated that, while the unquenchable walls of flame swept over and destroyed all other forms of buildings, less than five per cent of the reinforced concrete floors were materially damaged. So vast has now become the applications of Portland cement that the consumption of the past year totals the enormous utilization of over 80,000,000 barrels of this product. The interesting item to the electrical fraternity is, however, that in this production an installed capacity in electrical machinery of a third of a million horsepower is required.

Such rapidity of growth in an industry brought to light many interesting engineering problems. Unlooked for enlargements could never have been met had not the electric motor with its flexible independent drive been a possibility.

The detailed description of electricity as a factor in the development of the cement industry may be found on another page of this issue. The countless additional electrical powers necessary in the installation of the concrete sewers, water lines, telephone and telegraph posts, piles, bridges, barges and a thousand other applications make this industry a potent factor in the development of modern power consumption. Indeed the trend of the cement industry has gone one step further, for today in the concrete power houses and especially in the concrete pole construction the evolution of the hydroelectric art is itself put one notch higher.

It is interesting, too, to note that while electrical energy is thus a vital force in the manufacture of Portland cement, it is also in this self same industry affording the only safe method of preventing deleterious results from taking place.

In the manufacture of Portland cement by the

dry process many tons of fine dust are carried out of the kiln-stacks. The agricultural productivity of the surrounding district is consequently materially affected. It has been found that in a strongly magnetized field if a gas containing small suspended particles, such as dust, is passed through this field, the suspended particles are diverted from their upward course and deposit on the electrodes that supply the magnetized field. Thus at the Riverside Cement Company's plants in Southern California this process has been successfully applied and a stack-gas treater costing over $200,000 has there been recently installed. It would seem, then, that while new electrically propelled industries may at any time bring to life a harmful by-product, still this great unseen force when properly applied, may be made to correct every evil.

The Investigation Bureau

It makes little difference whether a human being is actually wronged or not. If he thinks he is wronged, the harm is done just the same and the utility company serving a community of ill-informed consumers may thus innocently expose itself to an onslaught wholly undeserved.

To fully protect itself from such unwarranted attacks, a wholesome educational and investigating campaign is absolutely indispensable on the part of the modern public utility company. This campaign should not be one of fitful starts or of sky-rocket acclaiming, but should rather by its even continuity of action impress the public with the evident spirit of fair play and earnest desire for quality in service that deep down, is the ruling motive for its establishment.

Electric service companies are fortunate in being free from two sins which from the very make up of the commodity sold to the public can never be laid at their door. In the first instance, electricity can not be frozen and in the second place no known method has ever been successful in adulterating the quality of this vital fluid. It is per se of one hundred per cent purity. About every other sin, however, for which Dante saw mortals roasting in the throes of his Inferno, has at one time or another, either justly or unjustly, been laid at the door of the hydroelectric or central station company.

Courtesy is a cheap commodity, yet it is surprising what it will accomplish when properly applied. The investigating department of a public service corporation is not the chamber of horrors it was some four or five years ago. In city service the alert utility companies of the West have accomplished by courtesy and conscientious effort a degree of efficiency and reduction of complaints far outranking any other class of public supply houses, such for instance as the grocer, the butcher, the baker or even the great department store. Those who have had access to the records bear up this statement without reservation.

In the agricultural or rural communities, however, the advance has been so rapid on all sides that the utility companies of the West have not kept pace with the needs or demands of this additional responsibility. Thus the over-zealous power salesman has urged the installation of larger pumping units than meet the best economic utilization of the rates agreed upon. Power lines have been promised and the farmer confidently planting his crops with full assurance of water for irrigation has been woefully disappointed in being able to connect up his pump at the appointed time. In other instances full details of possible costs for pumping installations have been misleading. Thus, a farmer is told that his pumping machinery and motor will cost so much, but upon completion of the task he has found that the "so much" did not include the concreting of the pit, the building of the pump shed, and a dozen other incidentals which in many cases have been known to double the cost of installation.

Again, the interest of the utility company should not end with the delivery of the current. A hundred other little niceties, tipped off to the farmer in his day of need and ignorance of matters electrical, will return a hundred fold to the power company in new consumers automatically "enthused" into using electrical energy by the well contented farmer.

New Records in Hydroelectric Development

The recent announcement that a 15,000 h.p. water power plant with but 30 cu. ft. of water per second dropping 5400 ft., is to be installed in Switzerland is a forceful reminder that fully apace with former years the trend of hydroelectric development is ever toward outdoing previous achievement. Last year witnessed the installation and initial operation of the largest water turbine units in existence at the White River plant of the Puget Sound Traction, Light & Power Company near Seattle. At present some sixty miles east of Fresno, California, on Big Creek, is being installed a 275 mile double steel tower transmission line from Big Creek to Los Angeles, which will break the world's record in voltage of transmission. Lake Spaulding in California, with its 300 ft. dam now under construction will submerge the deepest artificial lake ever attempted, while the Big Meadows dam in California proposes with its 50,000,000,000 cu. ft. of storage to outdo all other storage efforts in the world with the single exception of the Assouan Dam in Egypt. But not alone is Western effort to be found in the Pacific Coast States. Word has been received of the present activity of California electrical engineers in eastern Peru where an hydroelectric plant of the highest altitude in the world is being constructed. Thus the eastern slope of the Andes, tossing its waters from a 14,500 ft. elevation above the sea will once again remind the civilized world of the riches to be found in the classic land of the Incas. This time, however, the gold to be captured by the "invading Pizzaro" is not to be accomplished by fraud and treachery of the adventurous Spanish spoiler, but the modern Prescot in his "conquest of Peru" will be enabled to relate the wonders of the ever-conquering hydroelectric power now world-wide in its scope.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. N. Lauritzen, Pacific Coast manager for the Holophane Company, is at Los Angeles.

Samuel Curwen, president of the J. G. Brill Company of Philadelphia, is at San Francisco.

W. L. Goodwin, vice-president and general manager of the Pacific States Electric Company, is at Portland.

Frank Parrish has left the employ of the Western Electric Company at Seattle to become salesman for the Fobes Supply Company, Seattle.

H. E. Sanderson, Pacific Coast manager of the Bryant Electric Company, has returned to San Francisco from a trip through the Pacific Northwest.

Floyd G. Dessery announces the removal of his offices to suite 511-14 Central Building, Sixth and Main streets, Los Angeles, where he will continue practice as civil and hydraulic engineer.

M. M. Godman, an attorney of Seattle, has been appointed as chairman of the Washington Public Service Commission by Governor Lister. Mr. Godman succeeds George A. Lee, resigned.

R. W. Clark, formerly of the Minneapolis General Electric Company, has been made assistant sales manager of the Puget Sound Traction Light and Power Company instead of assistant manager as heretofore announced.

Dr. S. S. Wheeler, president of the Crocker-Wheeler Company, is at San Francisco to supervise Crocker-Wheeler business on the Pacific Coast and to look into the question of a Crocker-Wheeler exhibit at the Panama-Pacific Exposition.

S. K. Colby, vice-president of Allen and Peck, Inc., of New York City, and of Pierson, Roeding & Co. of San Francisco, was at San Francisco during the past week in connection with the formation of the Pacific Coast Electric Railway Association.

Roy Griswold, for some years engineer in charge of the Empire building and other properties in Seattle and patentee of an elevator door control design, providing for greater safety in the operation of elevators, has gone into the A. G. Electric & Manufacturing Company. He will have charge of the panel board and switch board department.

Mortimer Fleishhacker has been elected president of the Great Western Power Company; **Guy C. Earl**, vice-president; **H. P. Wilson**, vice-president and secretary; **Washington Dodge**, vice-president; **James Irvine, B. H. Dibblee, Chaffee E. Hall, W. H. Spaulding, A. C. Bedford, A. W. Burchard, W. S. Crandall, R. B. Young** and **C. E. Maynard**, directors, and **F. M. Tompkins**, treasurer.

Leslie W. Symmes and **Thos. H. Means**, agricultural engineers, together with **A. E. Chandler**, irrigation and water right specialist, who was formerly secretary of the American Engineering Corporation, have formed a new engineering firm to be known as Symmes, Means & Chandler, to undertake agricultural engineering. The firm will be located in the new Holbrook Building in San Francisco after May first.

Munson Burton, district manager for the Westinghouse Lamp Company, whose Pacific Coast business will hereafter be conducted independently, has organized his department at San Francisco with **H. H. Daley** and **H. H. Graham** as salesmen, **F. A. Youngholm**, treasurer, and **H. F. Hartzell**, correspondent. Mr. Daley and Mr. Graham are well known to the Pacific Coast trade, while Mr. Youngholm and Mr. Hartzell have come from the East to assume their new duties.

B. S. Josselyn has tendered his resignation as president of the Portland Railway, Light and Power Company, to take effect July 1, 1913, so as to get rest after six years service as the company's head. The board of directors at their meeting on March 26th passed resolutions expressing the good will of the company and the regret of all as to his decision. Portland business men signified their esteem for **C. M. Clark**, chairman of the board of directors of the company, and Mr. Josselyn, by assembling nearly 200 strong at a testimonial luncheon given in honor of them at the Commercial Club on March 27th.

SACRAMENTO REJUVENATION.

Sacramento, Cal., was put on the Jovian map on March 29th, when twenty-three members were admitted to the mysteries of Jovianism with the assistance of members from other California cities, under the direction of Statesman A. H. Halloran of San Francisco. The time was auspiciously opportune, for on this night Sacramento's new electrolier system was ablaze for the first time and added to the general brilliancy of the event.

Nearly half of the party of visiting Jovians took the journey by boat from San Francisco up the beautiful Sacramento River on the night of the 28th. This party was augmented by the presence of the ladies and entertained by cards and music on the way up, as well as by automobile sight-seeing excursion through the hospitality of the Sacramento electrical men.

Other members arrived from all quarters by twos and threes during the day, so that when the rejuvenation was called to order there were twenty-eight Jovians present. The ritual was well rendered by a team made up for the occasion except for the presence of five veterans. The degree team was as follows:

Jupiter, A. E. Drendell	Vulcan, A. V. Thompson
Neptune, G. I. Kinney	Mars, A. H. Elliott
Pluto, A. E. Rowe	Hercules, Geo. Curtis
Imps, J. A. Herr	Apollo, W. R. Dunbar
S. L. Hawkins	Avrenim, J. J. McKee
Frank Havey	Mercury, J. W. Redpath
Harry Sayles	

E. M. Schlessinger took care of the electrical effects and G. I. Kinney presided at the piano. The following were initiated and are now fully constituted members of the Jovian Order:

C. J. Asymus, Foreman State Department of Engineering.
J. L. Blide, Marysville.
A. P. Broughton, Foreman Electrician.
A. E. Commerford, Mgr. Commerford & Guckow.
W. C. Dolan, Electric Supply Co.
R. C. Eyerly, Supt. of Construction.
C. R. Gill, Supt. Elec. Distribution, Pac. Gas & Elec. Co.
J. C. Hobrecht, Electrical Contractor.
C. A. Lamus, Sec. Graham & Lamus Co.
J. W. McCurdy, Supt. Tel. & Tel. Asso. Oil Co.
G. H. Middlemiss, care Underground, Pac. Gas & Elec. Co.
A. J. Myers, Dis. Mgr. Wagner Elec. & Mfg. Co.
T. L. Nightingale, Supt. of Constr. Elec. Supply Co.
F. Osterloh, Asst. Chief Electrician.
G. S. Pearce, City Electrician.
A. P. Peck, Sales Mgr. Electric Supply Co.
H. J. Raffin, National Carbon Co.
W. B. Sawyer Jr., General Electric Co.
Tom Scott, Scott, Lyman & Stark.
W. A. Strand, Electrical Contractor.
W. H. Sutton, State Capitol Electrician.
H. K. Tackaberry, H. W. Johns-Manville Co.
Julius Wardell, Mgr. W. A. Strand.

After the rejuvenation a supper was served to fifty in the Elks' Club, A. L. Drendell presiding as toastmaster. A stirring address on co-operation was delivered by Albert H. Elliott, the other speakers being C. V. Schneider, W. A. Strand, G. D. Jones, W. S. Hanbridge, G. S. Pearce, Geo. Curtis and A. H. Halloran.

While the rejuvenation was in progress the ladies in the visiting party were entertained at the theater and by a card game, through the courtesy of the management of the Hotel Sacramento and the Sacramento ladies.

Special credit for the success of this rejuvenation is due to C. V. Schneider and Geo. Curtis, who devoted much time and energy in getting the class together and in perfecting local arrangements. The members of the degree team are also to be congratulated on their good work, great credit also being due to those out-of-town members who, by lending their presence to the meeting, greatly added to its success.

A message of good will and best wishes was received from Reigning Jupiter F. E. Watts just before the meeting, in which he gave notice of the appointment of A. E. Rowe as Statesman for Oakland, in recognition of his efforts at recent rejuvenations.

Announcement was also made of the fact that the San Francisco Jovians had ordered a magnificent set of new costumes for the degree team and that arrangements were being made for rejuvenations at Fresno, Santa Barbara and San Francisco within the next few months.

The Sacramento Jovians, now that the spirit of co-operation has been instilled, plan to form a lunch club and already have quite a nucleus of application for another rejuvenation at an early date.

PACIFIC COAST ELECTRIC RAILWAY ASSOCIATION.

The Pacific Coast Electric Railway Association was organized at San Francisco on April 1st at a meeting of the representatives of twenty-five electric railways operated in Washington, Oregon and California. The new association is a section of the American Electric Railway Association, which was represented by five officials, at the meeting—Charles N. Black, first vice-president of the national society and of the United Railroads of San Francisco; James H. McGraw, president of the McGraw Publishing Company of New York City; Harry C. Donnecker, secretary of the association, and E. H. Baker of the Galena Signal Oil Company, vice-president of the American Electric Railway Manufacturers' Association.

The Pacific Coast Electric Railway Association has been formed along the lines pursued by the New York State Association, the Central Association, which takes in Ohio, Indiana, Illinois and Iowa, and the Southwestern Association, which embraces Texas, all of which are sections of the national body. Its objects are to cultivate better public relations for street railways and secure publicity for the difficulties and problems of traction companies.

The project for holding the 1915 convention of the national organization in San Francisco originated at a meeting in New York City last January. In deciding so far in advance to hold the 1915 meeting in connection with the exposition the American Association departed from its usual custom, which is to postpone the decision until the year of the meeting.

The following officers were elected: President, Samuel Hild, general manager of the Portland Railway, Light and Power Company; first vice-president, T. T. C. Gregory, vice-president of the Vallejo and Northern line; second vice-president, A. W. Leonard of the Puget Sound International Railway and Power Company of Seattle; treasurer, Norman Logan of the Northern Electric Company; executive committee, T. T. C. Gregory, W. E. Dunn of the Los Angeles Railway Company, Paul Shoup of the Pacific Electric Company of Los Angeles, Charles N. Black, vice-president and general manager of the United Railroads of San Francisco, D. L. Huntington of Spokane, president of the Washington Water Power Company, Guy Talbot, president of the Pacific Light and Power Company of Portland, Ore., and W. R. Alberger, vice-president and general manager of the San Francisco-Oakland Terminal Railway Company.

REMOVAL NOTICES.

The Northern California Power Company, Consolidated, announces the removal of its offices to the David Hewes Building, 995 Market street, San Francisco, Cal.

The Westinghouse Electric and Manufacturing Company announce the removal of their Los Angeles offices to I. N. Van Nuys Building, corner of Seventh and Spring streets.

The Brooks-Follis Electric Corporation have moved their store from 24 Second street to 123-131 Second street, San Francisco, where more space and greater convenience will enable them to better handle their increasing business.

Chas. C. Moore & Company, engineers, are occupying temporary quarters at 40 First street, San Francisco, while a magnificent new building is being erected on the site which they have occupied at First and Mission streets since 1906. Ample warehouse and shop equipment has been secured in the neighborhood.

MEETING NOTICES.

Seattle Jovians.

The weekly meeting of the Seattle Jovian League held at the Rathskeller March 28th was an informal affair. The discussion revolved around the electrical pageant to be presented during the "Potlatch" this summer. The Jovians have decided to take an active part in making the pageant a success and the league will be represented by an appropriate float.

Alameda County Electrical Development League.

The regular monthly meeting of the Electrical Development League of Alameda County (California) was held at Oakland, March 29th. The principal subject for discussion was Senate Bill No. 738, which covers the licensing of persons engaged in making electrical installations. Mr. W. H. Gribble of the Kimball Electric Company gave a talk on the necessity of friendship and harmony between competitors before true co-operation can be attained. J. A. Vandergrift presided at the meeting.

The San Francisco Electrical Development and Jovian League.

The regular weekly meeting was held Tuesday last. Mr. Paul T. Carroll was the speaker of the day and addressed the members on the subject of co-operation of the Chamber of Commerce of San Francisco with the League. Mr. Carroll, in addition to being a director of the former organization, is also a director of the United States Chamber of Commerce. Upon the conclusion of his remarks resolutions were adopted looking toward the formation of an electrical committee of the chamber of commerce which shall be composed of League members who are also members of the chamber of commerce.

Portland Branch, N. E. L. A.

The next regular meeting of the Portland branch of the N. E. L. A. will be held at 8 p. m. on April 8, 1913, in the new hall of the Electric Circle of the Royal Academy, located on the northeast corner of First and Alder streets. Mr. E. A. West, the newly elected chairman, will preside. Dr. E. W. Lazell, Ph. D., will present a paper on "Design and Operation of Cement Plants." Dr. Lazell is one of the members of the firm of Edwards & Lazell, consulting chemical engineers, located in the Railway Exchange Building, Portland, Oregon.

Portland Electric Club.

This club is composed of employees of the Portland Railway, Light and Power Company, of which Mr. F. W. Hild is chairman. On Wednesday evening, March 26, 1913, Mr. C. M. Clark, chairman of the executive board of the concern, who resides in Philadelphia, gave a talk to the members of the organization.

Mr. Clark said in part: "It is your duty to serve the public honestly and faithfully. Therefore, when you come in contact with the error of a patron, explain to him the true situation, so that he may get a proper understandling of it. Loyalty and a conscientious performance of duty are the most important points in the career of an employee."

Other short talks were made by B. S. Josselyn, F. I. Fuller, C. M. Huggins and O. B. Caldwell.

Portland Jovian Luncheon Club.

Mr. W. H. Lines, industrial power engineer of the Portland Railway, Light and Power Company, gave the Jovian Luncheon Club a talk on "The Field for Industrial Power Development in This Country, and More Especially in Portland." Mr. Lines gave a large amount of interesting data and told of how industrial engineers had been attacking the problems submitted to them.

Mr. Geo. A. Boring, of the Pacific States Electric Company, was elected as the new member on the executive committee. Mr. C. P. Osborne was chairman. This finishes Mr. Osborne's term of office, and Mr. F. D. Weber of the Underwriters' Equitable Rating Bureau will preside as chairman for the month of April.

Due to the fact that Mr. E. G. Hopson, supervising engineer, U. S. R. S., has been called to Washington, D. C., on official business, it is impossible for him to address the Jovian Luncheon Club on April 10th. Consequently, Mr. L. R. Alderman, who has been recently appointed City Superintendent of Public Schools of Portland, will address the club on "The New Education."

Oregon Technical Club.

Governor West was unable to fill his engagement with the Oregon Technical Club and asked Mr. John T. Whistler to be his representative. Mr. Whistler spoke on the "Columbia Southern Project." He said in part:

"This project was started in 1902 and is far from complete now. The primary reason for its failure to date was the fact that the State never assumed any responsibility in the matter." The last Legislature came to the rescue of the settlers who were involved in this irrigation project and appropriated $450,000 to complete this project under the direction of the "Desert Land Board" of the State of Oregon. It is provided that this money and $5.00 per acre on the land in this project, when reclaimed, shall be set aside as a "revolving fund" for aid to other projects. The amount of land to be reclaimed is 22,000 acres."

Mr. H. R. Wakeman, chairman of the local section of the A. I. E. E., read the resolutions passed by the A. I. E. E. in regard to the appointment by the United States Congress of a "Patent Commission." Mr. W. H. Crawford, chairman of the day, suggested that every organization represented in the Oregon Technical Club take this matter up with their respective organizations and get endorsement of these resolutions.

The local chapter of the American Institute of Architects invited the members of the Oregon Technical Club to a lecture of "Fireproofing," to be delivered by Mr. McMasters of Youngstown, Pa., in their club rooms, 297½ Stark street, at 8:30 p. m., March 28, 1913.

Seattle Safety Committee.

The semi-annual banquet to the members of the safety committees, Seattle Division, Puget Sound Traction, Light and Power Company, was held at the Butler Hotel on the evening of March 20th. Officials and employees to the number of about 100 were present. George Carson, general claim agent, acted as toastmaster. Those responding were: D. W. Henderson, "The Old and the New Trainmen"; H. S. Elliott, "The Passenger and the Trainman"; R. R. Upton, "Safety in Its Relation to the Public"; A. J. Falknor, "The Unreported Accident"; G. A. Richardson, "The Safety Report and Its Value"; J. T. Rupli, "Relations Between the Trainmen and the Accident Investigators"; G. B. Harrington, "Barn Bogies"; A. L. Kempster. "Co-Operation." Among the invited guests were: A. W. Leonard, vice-president and general manager; James B. Howe, general counsel; W. J. Grambs, superintendent light and power; Frank Dabney, assistant treasurer; W. E. Best, auditor; Morton Ramsdell, sales manager; E. C. Gaumnitz, purchasing agent; Hugh A. Tait, attorney; A. J. Falknor, attorney; H. S. Elliott, attorney; N. W. Brockett, attorney; R. G. Sharpe, attorney; Park Weed Willis, chief surgeon; H. B. Thompson, surgeon; E. A. Batwell, publicity agent; J. E. Allison, superintendent of inspection; F. T. Marsh, superintendent of employment; J. T. Rupli, assistant claim agent; C. F. Young, adjuster, claim department; O. B. Ayers, adjuster, claim department; E. H. Worthen, investigator, claim department; R. R. Higley, investigator, claim department; C. Lidston, investigator, claim department; R. R. Upton, safety lecturer, claim department; C. L. Hammons, record clerk, claim department.

This organization, known as the Safety Committees, came into existence over a year ago, beginning with what is known as the Central Safety Committee and Division Safety Committees, afterwards organized. The organization of the committee was based on the idea of reducing the number of accidents to the smallest possible minimum. Every employee is a member of the "Safety League." Keeping a look-out for defective cars, defective tracks, defective tools, etc., and reporting to the chairman of the Central Safety Committee are some of the things required for the prevention of accidents. George Carson, general claim agent, is the present chairman of the Central Safety Committee.

BOOK REVIEWS.

Engineer's Handbook on Patents. By William Macomber. Size, 4½ x 7 inches; 288 pages; leather binding. Published by Little, Brown & Co. of Boston, and for sale at the Technical Book Shop, 106 Rialto Building, San Francisco. Price, $2.50.

The author of the work is a leading patent lawyer and professor of patent law in Cornell University Law School. He maintains the day of the whistling and whittling Yankee who managed occasionally to produce something patentable has passed, and that the important inventions of the future must be made by trained graduates of engineering school. In the "Engineer's Handbook on Patents" are presented the theories which underlie successful inventions and tend to guide the inventor on successful lines, both as to the law and the theory of patents. A careful study of the book will enable the user to avoid lines of thought which have resulted in past failures on the part of other inventors and will inform him of the steps necessary to secure for himself the full benefits of a successful invention. The matter of what is patentable is exceptionally detailed and complete, and the entire text is fortified by quotations from and citations to the decisions of courts of last resort. The book is certainly indispensable for Western engineers who seriously entertain taking out patents for their inventions.

Electricity and Magnetism. By Robert H. Hough and Walter M. Boehm. Size, 5½ x 7½ inches; 233 pages; 93 illustrations; cloth binding. Published by the Macmillan Company of New York, and for sale at the Technical Book Shop, 106 Rialto Building, San Francisco. Price, $1.10.

The authors of the book, both of the department of physics in the University of Pennsylvania, have conceived its contents as a leader in developing elementary principles of electricity and magnetism for students in engineering. The entire subject is logically covered and almost seven hundred equations are developed which are numbered and recapitulated for quick reference in the rear of the book. The book will not be found useful for non-technical students, but for those technically prepared and wishing to brush up on points in theory it is excellent. A commendable feature of the book is an extensive set of problems at the rear of each of the twenty-seven chapters, many of the answers to which are appended. The book has a comprehensive index. It will be found extremely useful for a text book in elementary courses of physics and should serve a useful reference for engineers not desiring the deeper books of reference such as Thomson and Maxwell.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

RECOMMENDATIONS FOR ELECTRICAL INSTALLATIONS IN WOOD WORKING PLANTS, MANUFACTURING PLANTS, WAREHOUSES, PACKING HOUSES. CANNERIES, MINING PLANTS, ETC.

COMPILED BY F. D. WEBER.[1]

The nature of the occupation carried on in buildings of the above mentioned character, subjects all types of "open and concealed" wiring to extremely severe mechanical injury, making deterioration very great and maintenance cost very high and the efficiency of the system extremely low. The presence of moisture, corrosive fumes, heat, salty atmosphere, pickling vapors, steam, etc., impose conditions which are extremely detrimental to all fittings, conductors, metal conduit and insulating materials. Also the presence of inflammable dust of all descriptions, accumulations of large quantities of inflammable materials and hard usage introduce a very pertinent fire hazard which demands special consideration.

After careful consideration of the various methods of wiring now in common use, we strongly recommend the installation of approved rigid or flexible iron conduit in all "special hazards," and more especially in wood-working plants, manufacturing plants, mining plants, packing houses, warehouses, canneries, etc. There being only a very few places where other methods of wiring can compete for recognition with approved rigid or flexible iron conduit, and it is an open question whether or not the conduit is not superior even under all conditions. Where conduit is subject to severe conditions, modifications in the methods of installation should be made, which will aid the conduit system to meet these special conditions and give satisfaction.

Conduit wiring when properly installed closely approaches the ideal, and it has the following advantages which should recommend it, safety, satisfactory operation, convenience, neatness, ultimate economy and flexibility as regards additions and changes; to existing systems, as conductors can be removed and replaced so readily.

"In all electrical work, conductors, however well insulated, should always be treated as bare to the end that under no conditions, existing or likely to exist, can a ground or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum."

"In all wiring special attention should be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, taping of conductors, and securing and attaching of fittings, are especially conducive to security and efficiency, and are strongly advised."

The following recommendations are based on requirements of the current edition of the National Electrical Code, and all wiring, apparatus, etc., not specifically mentioned herein must conform to the standard rules and requirements of the above mentioned Code. Rule references given are from the Code, and should be carefully read.

Where Current Is Generated at the Plant.

1. Generator and Switchboard should be located in the engine room if possible; when this is not practicable, a room should be especially provided for this purpose. The generator should be insulated from the ground and kept clean and dry, so as to prevent the accumulation of waste and dust. (Rule 1, sections a and b.)

2. Switchboard must be constructed of slate or marble mounted on an angle iron frame, or of hardwood in skeleton form, well filled to prevent absorption of moisture. Must be accessible from all sides, at least 18 inches from the wall and 10 or 12 inches from the floor, and not extend to the ceiling. The space back of the board must not be used for storage. (Rule 3.)

3. Conductors from the generator to the switchboard may be run exposed overhead, supported on porcelain knobs or single wire cleats, or may be placed under the floor if encased in continuous lengths of approved metal conduit. Each end of the conduit should extend well above the floor and be provided with an approved terminal bushing at the switchboard end and an outlet box or condulet at the generator end. (Rule 2.)

As specification for generators usually call for at least a 25 per cent overload for stipulated period of time (generally two hours) without injurious heating or sparking at the brushes, all leads, bus bars, switches, circuit breakers, ammeters, etc., used in connection therewith must in all such cases have a corresponding excess capacity over and above the normal rating of the machines.

Equalizer connections between generators should be as short, direct and as low resistance as practicable. Equalizer connections should not be less than area of main leads in generator, and never of a greater resistance than the series lead to bus bars.

Connections to balancing coils on the neutral leads of three wire generators should also be short, of ample capacity and low resistance.

For the carrying capacity of wires and cables see Rule 18 National Electrical Code.

Note: The question of voltage drop is not taken into consideration in the above tables.

4. Feeders from the switchboard to the centers of distribution or branch cutout cabinets must be installed in the same manner as hereinafter specified for branch circuits. (See Sections 7 and 11 of this article.

5. Feeders running out of doors to adjacent buildings should be of weatherproof insulation outside buildings, supported on petticoat glass insulators and kept 12 in. apart. Porcelain knobs or cleats must not be used where exposed to the weather. (Rule 12d.) These wires must enter and leave buildings in the manner of service wires hereinafter specified (in Section 7 of this pamphlet) for overhead service connections. (Rule 12f.)

It is advisable to have a main cutout and switch for each building, so arranged that the entire current may be cut off from each building. This cutout and switch may be placed in the cutout cabinet located nearest to point of entrance of feeder wires.

Where Current Is Supplied From an Outside Source.

6. Transformers should be located on poles in the yard at a safe distance from any building (at least 10 ft. from the walls of frame buildings). (Rule 14.)

"Where transformers are to be connected to high voltage circuits, it is necessary in many cases, for best protection to life and property, that the secondary system be permanently grounded, and provision should be made for it when the transformers are built." (Rules 14-15.)

Must not be placed inside of any building excepting central stations and substations (except as provided in Rule 36a, N. E. C.), unless by special permission of the Inspection Department having jurisdiction. (Rule 14a.)

Must not be attached to the outside walls of buildings, unless separated therefrom by substantial supports. Must not be attached to frame buildings when any other location is practicable. (Rule 14b.)

(To be continued.)

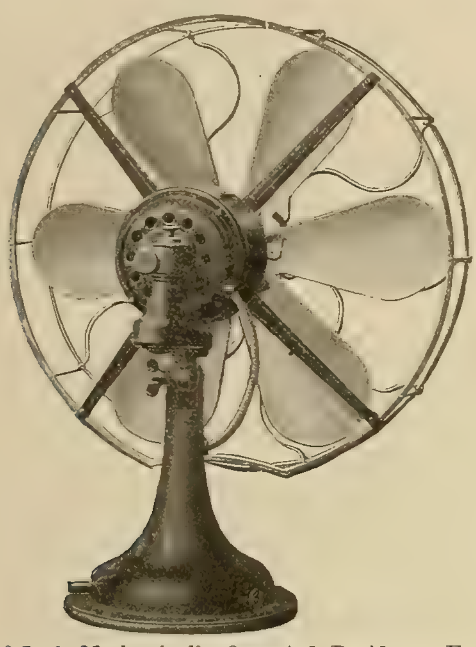
[1]Electrical Inspector for Underwriters' Equitable Rating Bureau, Portland, Ore.

INDUSTRIAL

WESTINGHOUSE 1913 FANS.

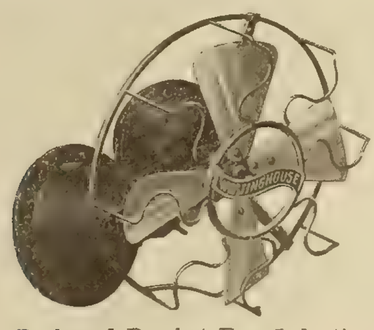
The attractive drawn steel frame fans introduced by the Westinghouse Electric and Manufacturing Company last year are continued for the 1913 season with such minor changes as experience has shown advisable. The quiet-running, six-blade type of fan has been extended to include the sixteen-inch size and the oscillating type.

There has also been added an induction-motor type of 8-inch fans to the line, this fan being constructed with drawn steel frame like the 12 and 16 inch sizes, and has a dull black finish. The Westinghouse line now includes 8-inch desk and bracket and telephone-booth fans and 12-inch and 16-inch fans in both four-blade and six-blade styles of the stationary desk and bracket type and the oscillating type; also 12-inch and 16-inch exhaust fans and a large variety of ceiling, counter and floor column fans.



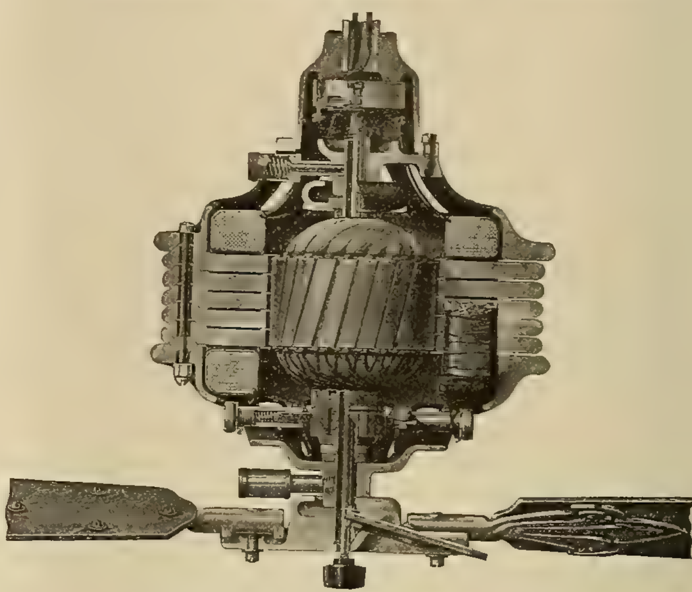
16-Inch Mechanically-Operated Residence Fan.

The popular six-blade 12-inch residence type has been extended this year to include the 16-inch fan also. This six-blade because of its slow speed is extremely quiet in operation and for this reason is particularly adapted to places where quiet is essential. The 12-inch size has already proved extremely popular in bedrooms, hospitals, professional offices and similar places, while the 16-inch size is designed especially for theaters, libraries, halls and other public places. Quiet operation is obtained by the use of a slow-speed motor, while the proper amount of air at this speed is moved by employing a six-blade fan.



8-Inch Desk and Bracket Fan, Induction Type.

A feature of the Westinghouse fans is a patented swivel and hinge joint which gives the highest possible range of vertical and horizontal adjustment. By the use of the wing nut adjustment the fan can be titled forward 15 deg., backward 90 deg. or rotated 340 deg., a stop ring preventing complete rotation so that there is no danger of breaking the leads. To change the fan from desk to bracket mounting, all that is necessary is to loosen the wing nut, tilt the fan backward to the desired angle, and then tighten the wing nut.



Cross-Section of 54-Inch D. C. Ceiling Fan.

Westinghouse oscillating fans are furnished in two types, mechanically operated and air operated. The mechanically operated fans have drawn steel frames and the oscillating mechanism is entirely enclosed and will not drop oil. It consists of a lever driven by a crank disc which is operated from the motor shaft by two gear reductions, a worm and a spur. The spur gear is the slow-speed reduction. Both the worm wheel and the worm can be renewed without tools. The worm wheel drives through a ball clutch. If the fan guard strikes an obstruction during the course of oscillation, the fan merely stops oscillating without interfering with the operation of the motor. This prevents the burning-out of the motor or the overturning of the fan. The oscillating movement can be stopped instantly by raising the knurled head on top of the mechanism and can be started by pushing this head down. Both operations can be effected while the fan is operating.

In the air operated oscillating fan the motor frame and the base are of cast iron. The position of a pivoted vane determines the direction of oscillation of the air operated fan. At the end of the oscillation a lever, geared to the vane, comes in contact with a stop and turns the vane 90 deg. The fan then swings around in the opposite direction until the lever comes in contact with a second stop, which turns the vane for oscillation in the opposite direction. The location of the stops is adjustable, so that the arc of oscillation can be varied from 30 deg. to 360 deg. in steps of 30 deg.

The Westinghouse alternating current ceiling fans are furnished for 56-inch and 32-inch blade sweep and the direct current for 57-inch, 54-inch and 32-inch blade sweep. The alternating current counter column and floor column fans are furnished for 56-inch sweep and the direct current fans for 57-inch sweep.

CHANGE IN PAISTE TAPLET LINES.

The H. T. Paiste Company has recently made some important changes in their pipe Taplet line so as to further standardize these economical conduit fittings. In order to minimize the amount of stock required by dealers, through greater interchangeability of material, certain changes have been made in the sizes of wiring openings so that now three sizes of pipe Tablet covers are all that are required for all sizes of pipe Taplets. That is to say the first size of fittings and covers fits all ½ in. and ¾ in. pipe Taplets; the second size fits all 1 in. and 1¼ in. pipe Taplets and the third size all 1½ in. and 2 in. pipe Taplets; this means that the stock of necessary covers and fittings may be practically reduced by a half.

These changes do not effect in any way the size and design of the opening in the ½ in. and ¾ in. sizes and these still fit the standard fielding receptacles and rosettes which have been used for years in wooden molding wiring. With this combination of ½ in. and ¾ in. pipe Taplets and fieldings the most flexible and economical forms of either lamp or cord outlets are secured.

A NEW VERTICAL MOTOR FOR CEMENT MILLS.

In order to provide a thoroughly satisfactory drive for vertical machinery (such as grinders and pulverizers) in cement mills and other places where the service is very severe, the Westinghouse Electric and Manufacturing Company has built a line of specially designed vertical motors in sizes varying from 75 to 200 h.p., for both direct and alternating current circuits. The special feature of this motor is its strong, rugged construction. The motor frame is supported by a massive cast-iron base, which rests on slide rails with belt-adjusting screws.

The shaft is of very large proportions and the bearings are designed to withstand the severest stresses. The weight of the motor and the major part of the horizontal thrust due to belt tension are carried by a ball-bearing mounted within the motor base. This bearing is housed in an iron case and can be easily removed if the necessity arises. The bearings are automatically oiled, the oil being forced between the bearing surfaces whenever the motor is in motion. The ball thrust bearing runs immersed in oil.

The pulley is mounted inside the thrust bearing, which, together with the strength of the shaft and the rigid support afforded by the motor base, insures the elimination of distortion due to the belt tension so that the proper clearance is always maintained between the stationary and rotating parts.

The commutation of direct current motor is practically sparkless, so that brush renewals are rarely required and commutators are long lived.

NEW PRODUCT OF THE HOLOPHANE WORKS.

The Holophane Works of the General Electric Company, Cleveland, Ohio, have just placed on the market a new product, Sudan glass reflectors in Panelex design. Sudan glass is absolutely new in chemical composition, of very delicate amber tint, when lighted, and translucent. Its smooth surface is said to be ideal for lighting service, for though its finish is practically dust-resisting, there is no polish or glare. Specks, spots and other flaws have been entirely eliminated.

The Panelex design of reflector is just as new as the Sudan glass. This new style of reflector is without marked ribs or hollows that would catch and hold dust, and the lamp filament is hidden from the ordinary line of vision. Sudan glass in the eminently practical Panelex design is said to demonstrate, to a new degree, large possibilities of light diffusion and re-direction without loss of artistic worth. The reflectors are made in both the bowl and shallow types, and are particularly desirable for use in office buildings, retail stores, and some rooms of residences.

OREGON RULING ON OUTLET CLAMPS.

In the past, during the "roughing in" of a job of "knob and tube" work, the general practice has been to use "friction tape" to secure flexible tubing to gas pipes at combination outlets and at "straight electric" outlets to depend on the friction between the bored holes in the "headers" and the flexible tubing and the twisting together of the wires at the outlets. This practice was only a "make shift" and sanctioned because there were no "approved devices" to substitute for it.

Now the Underwriters' Laboratories, Inc., have examined and issued a report covering an approved "outlet clamp" for this purpose. This clamp will be found listed on page 50 of the October, 1912, List of Approved Electrical Fittings. Therefore, after May 1, 1913, the Underwriters' Equitable Rating Bureau will insist upon the use of this approved "outlet clamp" on all "knob and tube" work installed in this State.

NEWS OF THE ELECTRICAL CONTRACTORS

The Sound Electric Company, Seattle, has the contract for putting in thirty 500-watt lamps in the new public market.

Buxbaum & Cooley, electrical contractors, 68 Columbia street, Seattle, have under way the job of wiring the new Vanneck Theater at Bremerton, Wash.

William A. Mullins Electric Company, 1014 A street, Tacoma, has received the contract for electrical work on St. Martin's College at Lacey, Washington.

The Pacific Fire Extinguisher Company have secured the contract for the electrical installation in the new Lawyers' Building, located on the southwest corner of Park and Washington streets, Portland.

Ne Page, McKenny & Company, Seattle, Wash., are just completing the new public library building in Portland, Oregon, and the Gray building on the northwest corner of Seventh and Morrison streets, Portland, Oregon.

The Reynolds Electric Company, formerly at 520 First Avenue South, Seattle, is now located at 310 First Avenue South. The company recently installed the electrical equipment on the presses of the Seattle Sun, the new evening paper

The Coast Engineering Company of Portland are installing the electrical equipment of the new moving picture theater that is being built by Foster & Kleiser. The theater is located on the east side of Sixth street, between Washington and Stout streets.

The M. J. Walsh & Company of Portland, Oregon, are installing the electrical installations in the Monarch Oil Company's new buildings, located north of the city on the Willamette River. They have also the electrical contract for factory No. 2 of the Portland Woolen mills located at St. Johns, Oregon.

Gray & Barash, electrical engineers, 63 Columbia street, Seattle, are installing an individual motor drive to take the place of steam driven equipment for the packing plant of Barton & Company on the tide flats. The motors vary in size from 2 to 40 h.p. They are all constant speed, two-phase, induction motors. The entire equipment was supplied by the General Electric Company, and 190 h.p. was contracted for from the Puget Sound Traction, Light & Power Company.

The Columbia Electric Company, Seattle, has the contract for furnishing the electrical fixtures for the Bellingham postoffice building. The same company has the contract for conduit wiring on the Bellingham National Bank, also for wiring the Presbyterian Church and the Byron Hotel in that city. Considerable work is also being prosecuted at Fort

Ward, Fort Casey and other points. R. H. Walker is manager for the company, with office and place of business at 1019 Columbia street.

The West Coast Engineering Company have been employed by the Hawley Pulp & Paper Company of Oregon City, Oregon, to install generating equipment in their mill for power and lighting purposes. The equipment will consist of one 150 kw., 480 volt, three-phase, 60 cycle alternator; one 80 kw., 480 volt, three-phase, 60 cycle alternator; one 75 h.p., 480 volt, three-phase, 60 cycle induction motor, and ten small size motors ranging from 3 to 10 h.p. Beside the installation of the above apparatus, new lines will be installed connecting all the mill units together on the same system, and the wiring will be completely overhauled throughout the plant. A new mill unit is also being built which will also be wired and in which will be installed the 80 kw. generator. Power for driving the generators will be furnished by water wheels which are already installed and which are a part of the original equipment of the mill.

The City of Portland, Ore., has awarded the contract for the lighting of the new Broadway bridge across the Willamette River to the West Coast Engineering Company of Portland. This work will cost the city approximately $21,000 and will result in what is claimed to be the finest lighted bridge in the world. There will be about two hundred two-light cast-iron brackets, and fifty five-light curb electroliers, on which will be used 100-watt Mazda lamps. There will also be a decorative system installed consisting of approximately seven thousand four-candlepower carbon lamps. This will all be permanent work, consisting of type R. J. condulets and Sheraduct conduit throughout. The lamps will be mounted upon all the main steel members of the bridge and along the sidewalk level, and it will be 18 inches between the lamps. The system which will be used on the Broadway bridge will present some special features in this construction, the details of which will be given after the work has been completed.

TRADE NOTES.

An order for a new switchboard has been placed by the Olympic Power Company with the Westinghouse Electric and Manufacturing Company for its power plant at Elwha Canyon near Port Angeles, Washington. It is an eleven-section circular-controlled desk board to replace the one destroyed by the flood some time ago.

The Oro Electric Corporation has awarded the contracts for its new transmission line material as follows: The towers will be furnished by the Aero Company, the Locke insulators by Pierson, Roeding & Co., and the sale for the copper was made by the Telephone-Electric Equipment Company, the metal being produced at the mills of the American Electrical Works.

E. J. Barry, electrical engineer for the St. Paul & Tacoma Lumber Company, at Tacoma, announces that the company has ordered a 1000 kw., 480 volt, three-phase turbo generator and is installing a 75 kw., three-wire d.c. turbo generator, switchboard, etc. The main generator is intended to operate completely the electrically driven planing mill and all auxiliary apparatus. The company is considering the advisability of an electrically driven sawmill.

The Alaska Water, Light & Telephone Company of Valdez, Alaska, has contracted with the Pelton Water Wheel Company for a 500 h.p. single discharge Pelton-Francis turbine with Pelton governor, fly-wheel and mechanically-operated relief valve. This turbine unit operates under 140 ft. head and is direct connected to a General Electric three-phase alternator. The current will be used for the company's lighting and power circuits in Valdez, and at Ft. Liscum, Alaska.

The General Electric Company has sold to the Pacific Gas and Electric Company for their station A in San Francisco a second 15,000 kw. 720 r.p.m. vertical Curtis turbine generating set with condenser base proportioned for 31,000 sq. ft. of cooling surface when equipped with one-inch tubes; also two CC4, 100 kw., 3000 r.p.m., 125 volt, flat compound wound Curtis turbine generator exciter sets and three 500 k.v.a. limiting reactances. The new turbine will have seven stages of expansion.

The A. G. Electric & Manufacturing Company, Seattle, reports a heavy increase in the steel box trade throughout the territory. A number of jobbers, especially in Seattle and Portland, are handling this line of manufacture exclusively and are finding it a very satisfactory account because of the large demand. Several decided improvements have been made recently, which have resulted in a clean cut attractive looking product. This is partially due to the electric spot weld method of construction adopted a short time ago, thereby eliminating all rivets. Other improvements include a deep cover for the box, increasing the dust proof qualities.

The Vancouver Island Power Company have recently placed a large contract with the Pelton Water Wheel Company for a lap-welded and riveted steel pipe line for their new Jordan River development. The lap-welded piping will be furnished by the Ferrum Company of Germany, for whom the Pelton Company are exclusive United States agents, while the riveted piping will be built in the Pelton Company's Harrisburg, Pa., shops. A 13,000 h.p. Pelton-Doble tangential water wheel is included in this award. The system of the Vancouver Island Power Company now have installed Pelton-Doble tangential water wheels aggregating 84,000 h.p. or a total of about 97,000 h.p. with the last unit recently contracted for and placed on the line.

The Westinghouse Electric & Manufacturing Company has just received an order from the New York Edison Company for one 21,000 k.v.a. turbo generator wound for either 6600 or 11,400 volts, three-phase, 25 cycle current, The generator has two poles and the speed of the set is 1500 r.p.m. The generator is ordered complete with Westinghouse LeBlanc condenser and accessories. This set is said to be one of the largest turbo generators every built in this country.

In addition to the above, the order also covers the following apparatus: one 3300 k.v.a., one 1285 k.v.a., one 3850 k.v.a., six 500 k.v.a., twenty-one 2000 k.v.a., three-phase air blast transformers and two 96 kw. booster sets consisting of one 150 h.p. direct current motor and two 48 kw. direct current generators wound for from 30 to 60 volts.

The San Joaquin Light & Power Corporation have engaged J. G. White & Company to do the engineering and supervise the construction of a 6000 kw. hydroelectric installation on the Tule River and a 6250 k.v.a. addition to the Bakersfield plant. At Tule River there will be two 3000 kw. units, the contract for both the wheels and the generators having been awarded to the Allis-Chalmers Company. A 6250 k.v.a. unit is also to be added to the Bakersfield steam plant, Allis-Chalmers Company having the contract for the turbo-generators, and Charles C. Moore & Co. for the Stirling boilers. This will give the Bakersfield plant a total capacity of 15,000 kw. J. G. White & Co. are also preparing specifications and asking for bids for a 3000 kw. installation at the new San Joaquin No. 2 power house and the north fork of the San Joaquin River which will use the water from plants Nos. 1 and 3. The reconstruction of the small hydroelectric plant at the mouth of the Kern River is also contemplated so as to use existing power to better advantage. A 1500 k.v.a. steam turbine auxiliary is also proposed at Santa Maria to insure service now being supplied by transmission line.

NEWS NOTES

INCORPORATIONS.

MEDFORD, ORE.—Application has been made for the incorporation of the Medford & Interurban Railway, and J. G. Griffith of Oakland, Cal., and S. S Bullis of New York City are reported as backers of the enterprise. Mr. Griffith will be in Medford in a few days and meet with Mr. Bullis who is now here, when the final arrangements will be made. It is generally understood that Mr. Bullis has an option on the Barnum railroad.

RENO, NEV.—Articles of incorporation for the Rochester Water Company have just been prepared with a capital stock of $150,000 for the purpose of supplying the towns of Rochester Canyon with clear water from Indian Peak, a distance of four miles from the upper camp. The company has been formed by J. G. Huntington, Judge J. M. Savage, Frank Richardson, M. Castle and F. B. Hargett, all of Rochester. They claim to have a gravity system to bring the water into the head.

TRANSMISSION.

SAN FRANCISCO, CAL.—The contract for electric current used by the harbor commissioners will expire June 30.

WHITE SALMON, WASH.—The Northwest Electric Company has purchased a 160 acre tract from Roy Chubb, a few miles above Husum Falls, containing a power site to be developed as part of the company's system.

MARTINEZ, CAL.—Eingineers are stringing two new power line cables across Carquinez straits for the Pacific Gas & Electric Company to increase the facilities for supplying electric light and power for the exposition grounds in San Francisco.

KIRKLAND, WASH.—The Puget Sound Traction, Light & Power Company, Seattle, has made application to the town council of Kirkland across Lake Washington for a light and power franchise. Extensive developments are being carried forward in that section.

FRESNO, CAL.—The board of supervisors has passed an ordinance granting a franchise to the Pacific Light & Power Corporation to construct and for the period of 50 years to operate and maintain an electric tower and wire system across certain public highways in the county of Fresno.

ONTARIO, ORE.—Representatives of the Beaver River Power Company, the principal office of which is in Boise, were in Ontario recently looking over the field, and announced that their company will apply for a franchise here in the near future. The company is extending its line through the Snake River valley and will enter the electric lighting field of Nyssa, Ontario and Vale.

SAN FRANCISCO, CAL.—An application has been filed with the railroad commission asking modifications as to the use of the money to be derived from the sale of $5,000,000 bonds of the Pacific Gas & Electric Company, the issuance of which was authorized last September by the commission. The original order allowed these uses to be made of the money: Construction account of the Drum power plant to 40,000 kw., $1,650,000; transmission lines from the Drum power plant to Cordelia, $1,389,000; construction account dam and spillway, $2,280,000; canal, etc., from Lake Spaulding to Drum power plant, $1,274,500; water department, $1,250,000. The company desires to divert $590,000 of the money for increasing the capacity of the Bear River Canal from 50 cu. ft. of water a second to 350 cu. ft. It also desires to build three new power houses, one near Clipper Gap, one near Auburn and one in Auburn ravine, north of Newcastle, at a cost of $2,396,000. These plants will have an installed capacity of 35,000 kw., and an average capacity of 26,000, the cost of developing thus being $6845. The company in its application states that it is not only engaged in work on the Drum plant, but that by the concrete dam at the outlet of Lake Spaulding, which is under way, four billion cubic feet of water will be added to the supply of two billion feet now impounded in its 15 reservoirs in the Sierra. But this dam will not be completed this year. During 1913 it will be up to 260 ft. and will impound three billion feet, and the full capacity cannot be reached until 1914, when it will be 300 ft. high. In the meantime the Drum power house will be running under a light load, and it is the opinion of the officers of the company that it is advisable to use some of the proceeds of bond sales in the three new power houses and on the Bear River canal.

ILLUMINATION.

OREGON CITY, ORE.—A franchise has been granted to the Beattie Gas Company to install a plant and sell gas in Oregon City.

BALBOA, CAL.—The West Coast Gas Company is enlarging its plant and installing a high pressure system at a cost of $37,550.

YUMA, ARIZ.—It is reported that the Southern Pacific Company intends very shortly to put in an electric lighting plant of its own at Yuma to supply light to its shops and yards.

WENATCHEE, WASH.—The Wenatchee Valley Gas & Electric Company has decided to erect a gas plant here and to pipe the city. The cost is estimated at about $100,000. The work of laying pipes will commence at once.

VENICE, CAL.—The city trustees of Venice have awarded the contract to the Coast Electric & Machinery Company for $14,940 for the installation of the ornamental lighting system in all streets and in the section of the city between Zephyr avenue and Marine street and trolley way to the Ocean front. Ornamental concrete posts will be used.

LOS ANGELES, CAL.—At a banquet held by the chamber of commerce of Huntington Park, a project was launched to light Long Beach avenue from Huntington Park to the sea. The chamber of commerce has been quietly conducting preliminary plans for lighting this last 15 miles of speedway, and when the matter was taken up the co-operation of Long Beach, Huntington Beach and Cudahy city was secured.

KLAMATH FALLS, ORE.—Klamath Falls is now receiving encouragement for a municipal light plant and an opportunity to use for the benefit of the people at least a part of the 200,000 h.p. of Link River, connecting the Upper Klamath Lake and Lake Ewauna, which river runs through the city of Klamath Falls. The U. S. Reclamation Service is to aid Klamath Falls in securing the free use of the waterpower, or as much thereof as the city can use.

SACRAMENTO, CAL.—After several months' labor in getting together data City Engineer Givan has closed his reports to the city commission on subjects relative to the forthcoming municipal improvement bond election by submitting a report on the municipal electrical distributing plant, the total cost of which is estimated at $113,600. Givan recommends that the transforming station be located on the city

property recently acquired at Thirty-first and R streets, as it will be near the center of distribution. The substation is to be of fireproof material and its equipment will consist of such machinery as may be necessary for the character of work to be undertaken. The distributing center proper is to consist of 75 miles of pole lines, consisting of 3050 cedar poles and 125 miles of weatherproof wire and 825 inclosed series direct current street lamps with all necessary accessories. Givan estimates the saving to the city at $13,740 per annum for the distributing plant. Contrary to a popular idea, the intention of the city commission is to go into competition with the power companies, as the manufacture of electrical energy is not contemplated. The distributing plant is merely that physical property for which the city property now pays an annual lease of $5.50 per lamp per month, and for which no other power company but the Pacific Gas & Electric Company can bid because that corporation owns the distributing plant. The city officials desire that the municipality own its plant, so that all power companies can bid for the contract to furnish the city with electrical energy. It is believed by that means a rate much lower than ever received will be obtainable.

TRANSPORTATION.

TIGARDVILLE, ORE.—Citizens are making an effort to have the Newberg and McMinnville Electric Railway extended to this place.

MEDFORD, ORE.—M. T. Minney Company, Oakland, has transferred franchise for interurban to F. B. Waite, Roseburg, and associates. Work is to be started before April 10 and rushed to completion.

PORTLAND, ORE.—The state railroad commission has advised the East Side Commercial Club that authority to force the Portland Railway, Light & Power Company to establish cross-town lines lies with the city. One line will be requested.

SAN FRANCISCO, CAL.—The supervisors have passed to print by unanimous vote the ordinance authorizing the board of public works to let the contract for the extension of the Geary Street Municipal Railway to the ocean beach via Thirty-third avenue, Balboa street, Forty-fifth avenue and Cabrillo street.

RIVERSIDE, CAL.—Bids have been received by the city council for two trolley franchises for which the Pacific Electric Company recently made application. The bid for the Magnolia avenue franchise to connect Riverside with Corona, $100, was accepted. The bid of $250 for the Market street franchise was held up pending matters in dispute between the city and the Pacific Electric Company.

OROVILLE, CAL.—A contract has been let by the Northern Electric Railway Company for a new freight depot in this city. The depot when completed will cost about $8000. S. T. Cobb, a local contractor, will have charge of the work. The old depot was totally destroyed by fire a short time ago. It is stated that as soon as the freight depot is completed, work will be begun on a new passenger depot.

LOS ANGELES CAL.—At a recent conference between the city officials and representatives of the Pacific Electric Company steps were taken toward the immediate relief of Main street traffic congestion. The company has agreed to make an opening in the rear of the present Sixth street depot, install a necessary bridge across Los Angeles street and a stairway for accommodation of southbound passengers and to have tracks at rear of the depot in operation within a week.

POMONA, CAL.—Extensive improvements which have been under way on Pacific Electric property on South Garey avenue are now practically completed. Four spur tracks have been run off the Garey avenue line just below the Pacific Electric station, and two continue on and connect with the Fifth street line for switching cars. It is evident improvements are being made with a view to eventually extending the line on through Chino and Corona, and also to care for additional traffic caused by the building of the Riverside-San Bernardino extension.

SEATTLE, WASH.—State Treasurer Meath, City Comptroller Carroll and Mayor Cotterill have opened negotiations for the sale of $300,000 of the $800,000 municipal street railway bond issue to the state, in accordance with Mr. Meath's letter to Mr. Carroll saying that the state would consider the purchase of the bonds. The sale of a portion of the municipal railway bonds is to be made for the purpose of reimbursing other city funds from which loans were made for the construction of division "A" of the city's street railway, beginning at Third avenue and Olive street and extending to Thirteenth avenue west and Nickerson street. A week ago the city council rejected three bids for these bonds as being too low, the council holding that the municipal street railway bonds were as good as any bonds issued by the city.

OAKLAND, CAL.—The railroad commission has issued an order in the matter of the application of the San Francisco-Oakland Terminals Railways to restore the rate to 20c. formally establishing the 15c rate on the following basis: Between Oakland and Davis street, San Lorenzo, 5c; between Davis street and Ashland Station, 5c; between Ashland Station and Hayward, 5c. In response to the petition of patrons of the road that there be a reduction in the commutation rate of $5 between Oakland and Hayward the commission fixed the rate at $4.50 for the entire month and $4 without the Sunday privilege. The petition of the Hayward chamber of commerce that the Western Pacific be directed to grant commutation rates was referred back to the chamber without prejudice, the commission holding that the case as it stood was not competent. The chamber of commerce was asked to submit evidence in the event of the petition being renewed.

TELEPHONE AND TELEGRAPH.

JEWELL, ORE.—The Centennial Telephone Company is planning to extend its system here.

PENDLETON, ORE.—Independent Telephone Company, Pilot Rock, have applied for a franchise here.

ESCALON, CAL.—The Escalon Telephone Company will soon commence the construction of a telephone line north of town.

EL CENTRO, CAL.—The Imperial Telephone Company has been granted permission to lay all its wires underground before street paving commences.

HOOD RIVER, ORE.—The county commissioners have been petitioned for a franchise for lines upon the county roads in Little White Salmon Valley west of the river, by the Underwood Telephone Company.

VICTORIA, B. C.—The Hon. Minister of Lands will receive bids until April 14 for the Forest Branch telephone equipment. H. R. McMillan, chief forester, Forest Branch, Department of Lands, Victoria, B. C.

OLYMPIA, WASH.—Charges that the Pacific Telephone & Telegraph Company, the Sunset Telephone & Telegraph Company and the Independent Telephone Company of Seattle, in violation of the order of the public service commission, have wilfully failed, neglected and refused to receive and transmit messages of the Northwest Long Distance Telephone Company, and have established unreasonable, unfair and discriminatory rules for the transaction of business, are made in a complaint filed by the Northwest company with the public service commission.

PROFESSIONAL DIRECTORY

ALPHABETICAL INDEX TO ADVERTISERS

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Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
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Keystone Boiler Works
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Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
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Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

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Conduit, Rigid
"Economy," "Sherarduct," National Metal Molding Co.
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D. & W. Fuse Company
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"Century," R. J. Davis
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General Electric Company
Pacific States Electric Co.
Sprague Electric Works
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American Ever-Ready Co.
Pacific States Electric Co.

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General Electric Company
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Pacific States Electric Co.
Westinghouse E. & M. Co.

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D. & W. Fuse Company
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Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

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Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pass & Seymour
San Francisco, Rialto Bldg.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
San Francisco, Monadnock Bldg

Post Co., The Frederick
San Francisco, 135 Second

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg

Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Pass & Seymour.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill,"Pierson, Roeding & Co.
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.
Switches, Push Button
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Tubes and Bushings
Ohio Brass Company
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee,"Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co.,The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758W.Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 PacificBlg.
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco,682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

WANTED—Operating position by a young man; 4 years' hydro-electric experience; A-1 machinist; temperate; Rockies or West preferred; isolation no difference; references from present employers. Address Box 3, Journal of Electricity, Power and Gas, Rialto Bldg., San Francisco, Cal.

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pure asbestos insulated (round or rectangular) is used in armature or field coils.

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WESTERN ELECTRIC COMPANY
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GRIMSHAW

Our Tapes are made of the strongest sheeting obtainable. The compound is rubber, not tar or pitch and it is calendered into, not merely spread on the sheeting. These features are costly but they make tapes that are stronger, stick faster, insulate better, and keep fresh longer than brands without them.

Insulating Tapes

The extra quality is more than worth the extra cost. Increased annual sales for over a quarter century shows others have found it so.
You will too—try these brands the next tape you buy.
From your dealer or

New York Insulated Wire Co.
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San Francisco
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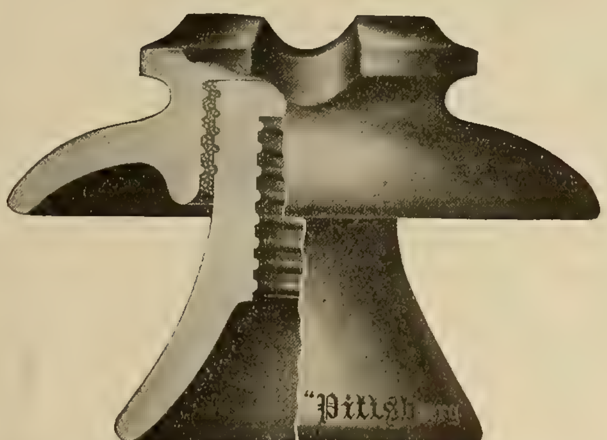
COMPETITION

"Pittsburg" INSULATORS



have been proven out by the majority of the largest operating companies in the United States, South America, Mexico and Canada. Their repeat orders denote satisfaction.

Designed and made to give high efficiency service under the most severe conditions. For all voltages from telephone and telegraph upward.

6

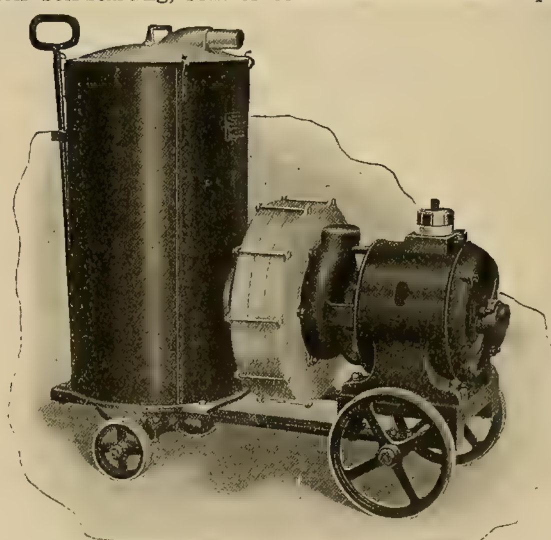
The Pittsburg High Voltage Insulator Co.

Main Office and Factory: Derry, Pa.

New York Office, 114 Liberty St. St. Louis Office, 301 South 7th St.
Seattle Office, 115 Prefontain St. San Francisco Office, 247 Minna St.
Los Angeles Office, 120 S. Los Angeles St.

Century SINGLE PHASE MOTORS

Are exceptionally well balanced and quiet in operation. These facts, taken into consideration in connection with their self-starting, remote control and automatic opera-



tion features, have placed them in superior favor for the operation of vacuum cleaners, organ blowers, heating and ventilating fans, etc.

¼ to 40 Horse Power—25 to 140 Cycles.

CENTURY ELECTRIC CO.

19th and Olive Sts., St. Louis, Mo.

Western Sales Offices and Stocks at San Francisco, Los Angeles, Portland, Seattle, Spokane, Salt Lake City

The Meaning of Mazda

The Magi, or Magicians, fire worshippers, priests of the Presian god Mazda, in their ritual many thousand years ago, were wont to carry the sacred flame on a salver or tray. Their reputation for learning and wisdom has survived throughout the ages until today it appears in our language in the word "Magic."

The problem of artificial illumination has always occupied the attention of mankind. The earliest knowledge that we have of the human race centers about a religion in which light and fire and the heavenly bodies were worshipped under the form of a god—Ahura Mazda (Divine Wisdom), whose cult under the Prophet Zoroaster and the Magicians became the guiding spirit of civilization for the whole of the then known world.

This dim voice of the remote past is the first known link in a chain of investigation, research and invention which has bound over sixty centuries of mankind, comprising within its folds the history of civilization and ending in the various achievements of modern science. The last link, following the revolutionary discovery of the incandescent electric light by Thomas A. Edison in 1879, has been the perfection of a system of artificial illumination employing the electric current and the Edison Mazda Lamp,—a system which offers a solution of the age-long problem of light for everybody.

It is not unfitting that early historic aspiration and endeavor should be joined with present achievement; it is not unfitting that a name should be established in our language for the best light which scientists and manufacturers can produce—a name which shall always denote the most nearly perfect incandescent light nature can offer and man can control.—MAZDA.

General Electric Company

Largest Electrical Manufacturer in the World

General Office: Schenectady, N. Y.

Pacific Coast Sales Offices in San Francisco, Los Angeles, Portland, Seattle and Spokane
Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho

3998

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

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MATERIALS ADVERTISED IN THIS ISSUE

Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**

REGINA CLEANERS.—Gold Medal Winners for their efficiency over all other makes of electric vacuum cleaners entered at the California State Fair, 1912.

Do You Know REGINA Electric Vacuum Cleaners

—little giants of power that will lighten the daily labors of every household, or even the office?

Better post the folks! They'll be interested for it means a great saving of time, labor and worry to the housewife. Let electricity do the drudgery.

REGINA cleaners are light of weight, simple of construction and operation and possess a low running cost.

Equipped with two separate motor driven pumps, working alternately at the rate of 2400 impulses per minute, producing a continuous suction.

Dust bag is so located that the dirt gathered does not come in contact with the machine, obviating damage to the working parts, while the bag can be emptied without fussing with any troublesome bolts or screws.

No complicated mechanism to get out of order — All parts interchangeable — Let us show you.

PACIFIC STATES ELECTRIC CO.

The Modern Electrical Supply House

DISTRIBUTORS FOR THE PACIFIC COAST

SAN FRANCISCO OAKLAND LOS ANGELES PORTLAND SEATTLE

JOHN A. BRITTON
Vice-President and General Manager,
Pacific Gas & Electric Company

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX — SAN FRANCISCO, APRIL 12, 1913 — NUMBER 15

ACCOUNTING UNDER UTILITY REGULATION[1]

BY JOHN A. BRITTON.

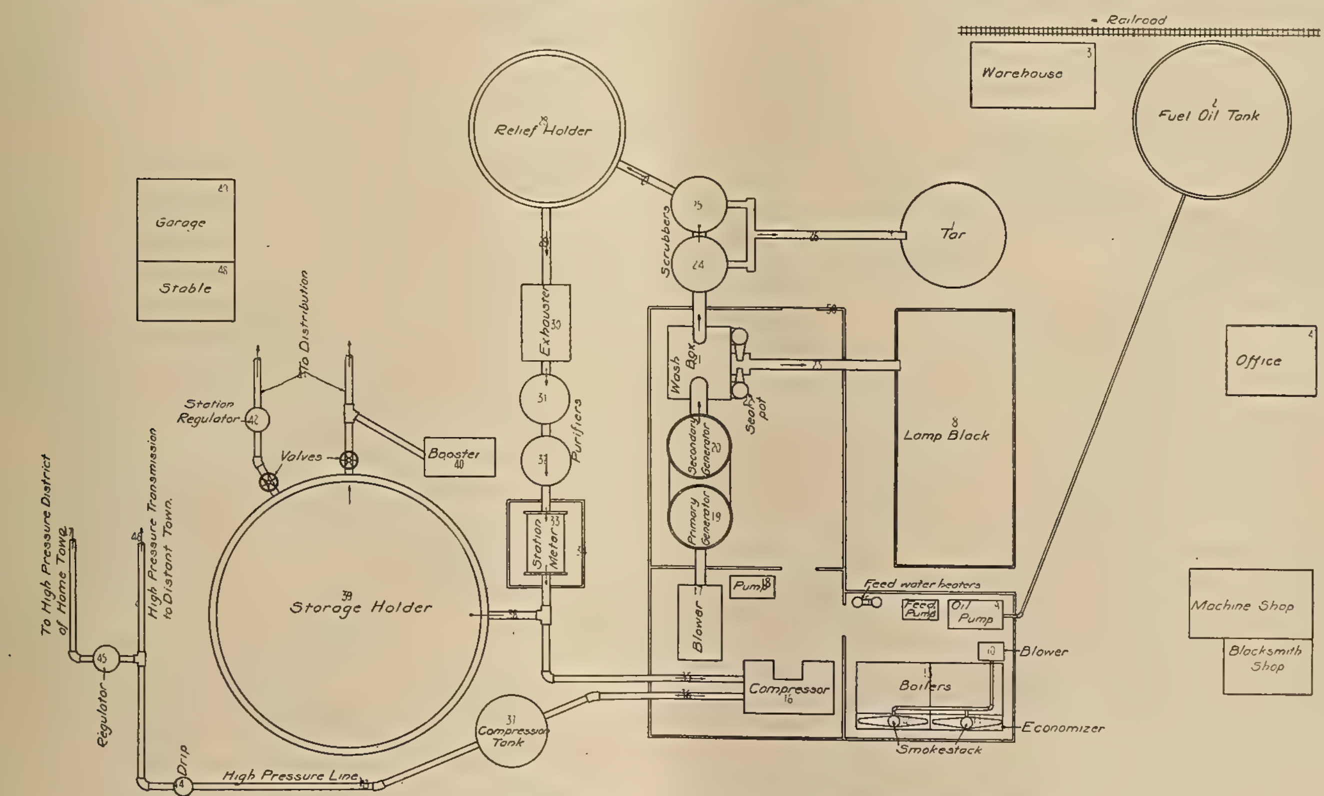
I have been asked to speak on the subject of accounting as directly applied to Gas Engineering. At the outset I desire to differentiate between bookkeeping and accounting, for I would not wish for any aspiring engineer to become a mere bookkeeper, slave of the pen and pad, an imitator, or mere creature of debit and credit. But of accounting you should and must be masters, else your work will fail of its greatest worth—accuracy.

"Accurate" is defined as "In exact or careful conformity to truth, or to some standard requirement the result of care or pains; free from failure, error or defect; exact."

This definition aptly fits the requirement of an engineer in his dealings with the world, and if employed as a guide and rule, subject always of course to human frailties, spells success, deviated from materially spells failure.

To insure accuracy, or mathematical precision, presupposes a knowledge of the equations that are the result of careful thought and keen analysis, and there is no training of an engineer that will better fit him for the confidence of his clients and the public at large, than the superior knowledge of the classification of accounts.

The engineer of today is the factor in determination of the status of his client, before courts and commission, greater than the lawyer who pleads the case. Not only must he know the engineering details, and be familiar with the formulae that sustain his reason, but he must also fully know the data that tie them in to the particular part of the plant that he

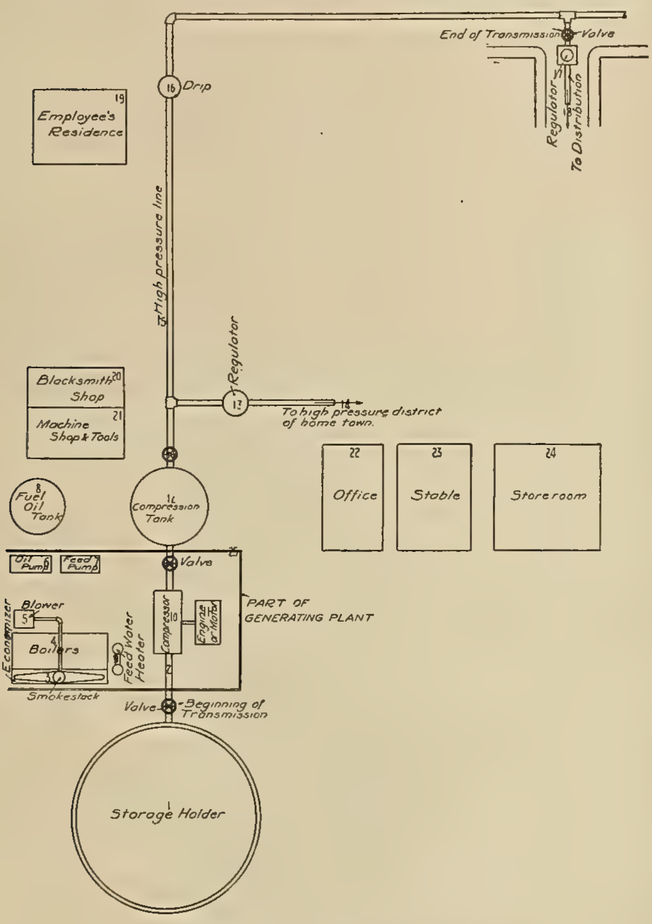


Details of Apparatus Used in the Generating Department of a Gas Works, Indicating the Refinements of Accounting Used.

[1]Lecture delivered before students in gas engineering at the University of California.

has made a study of. He must know its relation to the particular part of the account that it is chargeable to; he must know of the particular relation one to the other of sources of revenue, of the differential between capital accounts and operating, maintenance, replacements, distribution, general and administrative expense, as they each and all have a part to play in his determination of proper costs.

It is only of a very recent date that engineers have been compelled to acquaint themselves with the minutia and detail of account keeping, and to advise



Accounting Chart for Transmission Section.

themselves of the general intricacies of corporation accounting. This has been brought about primarily by the keen supervision that the government, national, state, and all the political subdivisions of the state, exercises over all public utility bodies, in which supervision is under the regulation of the public service utility acts in force in many of the states, prescribing the method, form and manner in which the accounts of all such corporations must be kept. It is not enough for a gas engineer to know the principles of his profession as applied to the mechanical or chemical branches, but he must be thoroughly familiar with the accounts that are prescribed for each branch, that he may on examination of, or reporting on an enterprise know accurately to which particular and peculiar phase of the accounts each item belongs.

This exactitude of corporation accounting, which is very rapidly becoming standardized all over the world, causes, so to speak, every man to express himself in the same language. There is no longer any uncertainties as to what is meant in these expressions. Formerly men in the gas world spoke many tongues and a convention of them was like unto the Tower of Babel, but experience has taught us the value of this standardization, and one plant must by its work stand comparison with the other on exactly the same basis.

Let us now consider the various divisions into which the capital invested in the plants of a gas company are divided. These may be classed as general, generating, transmission and distribution, and will be so treated in the following discussion. Illustration as shown herewith indicate the minute detail in which these segregated accounts are kept.

Accounting in General.

I will now read you excerpts from instructions issued by the Pacific Gas and Electric Company by its accounting departments to the several districts and divisions governing the question of accounting as applied to that company.

The desirability of uniform accounts as the basis of uniform reports, for the same classes of operations of industries, has been recognized by an ever-increasing number of accountants, economists, government officials and public writers. Past experience demonstrates, however, that if this uniformity is ever to be attained, it must follow the acceptance of a common language of accounts, or the use by all of common terms, with the same significance. This is of especial benefit to the economical administration of corporations covering a large territory, enabling the comparison of varied experiences and efforts in the divisions and districts.

To open the way for this common use of terms, schedules and schemes of uniform accounts should be accompanied with a carefully developed nomenclature, and definitions of all terms employed. The benefits to be derived from standardizing accounts, depend upon their careful application by the people compiling the figures and the assistance which they furnish in the economical administration of the business. The assistance which they should render is stated in the following definition of accounting:

Accounting may be defined as a scientific analysis, record and summary of business transactions, or as the art of analyzing, recording and summarizing data, relative to financial business, in such a manner as to disclose the condition or state of that business at any given time; to express the results or outcome of its transactions, for any given period, in terms of its objects or purposes; and to furnish all other information that such analysis, record or summarizing can furnish, for its systematic and most successful administration.

In applying the science of accounting to the successful administration of a business or enterprise for gain, such as are all public service corporations, two principal classes of accounts are always employed. The first is known as balance sheet or general ledger accounts, and the second as gain and loss accounts. In addition to the two principal classes of accounts mentioned above, the greater number of public and private enterprises keep additional or supplemental accounts, to aid in furnishing other information, needed for their systematic and scientific administration.

These accounts of a public or private enterprise are its ledger accounts, in which are recorded the

financial data which, when properly summed up on a statement generally called a balance sheet, or statement of affairs, will present a correct exhibit of its financial condition at a specified time, by setting forth the value or amount of its resources or capital; the amount of the claim of its creditors, or liabilities; and that of the equities of its proprietors, or proprietary interests.

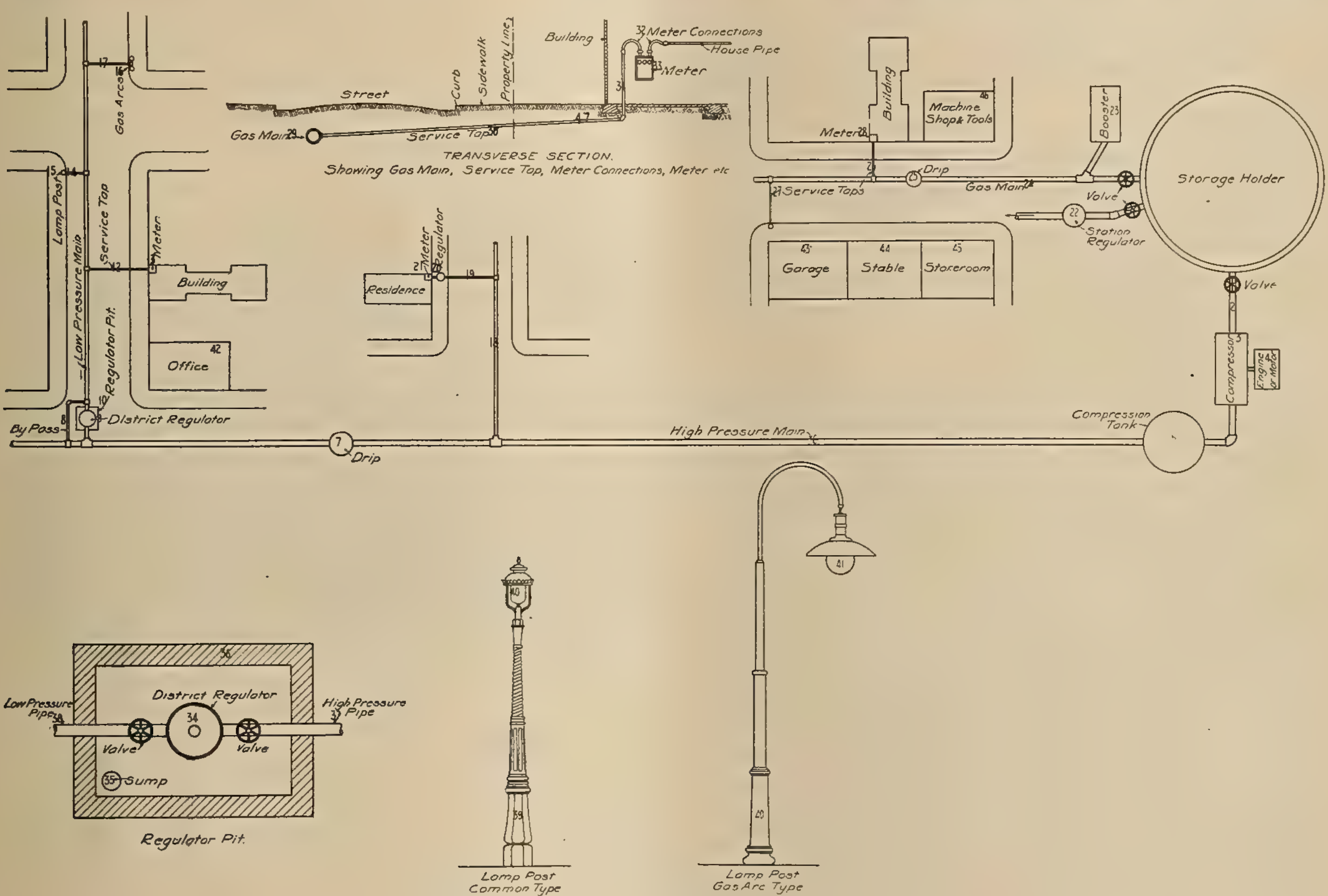
The gain and loss accounts of a business or enterprise conducted for gain are the accounts, which when properly summed up, disclose the results or outcome of its business operations, for a given period of time. These accounts may be called revenue and expense accounts.

warehouses), and the cost of further transportation to the place of consumption, in which case a corresponding credit shall be made to the suitable expense account as herein provided.

Cost of repairs includes cost of labor expended and material consumed, less salvage, if any.

As the term is used herein, by **capital of a corporation,** is meant all property devoted to the tendering of the services, or the production of the commodities, which are within the purposes of the corporation.

Capital which has an expectation of life in service of more than one year, (exception being made of hand and other small portable tools, liable to be lost



Distribution Chart for Gas Works Accounting.

Definitions.

Except where some other meaning is clearly specified in the definitions of the accounts, the following words, wherever used herein, have the meanings below stated:

Cost means cash or money cost, and not price based on a term of credit.

Labor means human services of whatever character.

Cost of labor includes wages, salaries and fees, paid to persons for their services.

Cost of materials and supplies includes all specifically assignable transportation charges incurred in obtaining the delivery of such materials and supplies upon the premises of the purchaser and the cost of any special tests made thereon prior to their acceptance; also a suitable proportion of warehouse expenses (where the materials and supplies are passed through

or stolen, and which are not listed as to number and location), is called **fixed capital.**

Capital other than fixed capital is called **floating capital.**

Fixed capital is divisible into general capital and departmental capital, **general capital** being that which is indiscriminately available for the use of two or more classes of operations, while **departmental capital** is that assigned solely or principally to a single class of operations.

Fixed capital is also divisible into landed capital and non-landed capital. **Landed capital** includes all interests in land (exclusive of improvements thereon), the term of which is more than one year. All other fixed capital is herein called **non-landed capital.**

Non-landed capital is divisible into intangible capital and tangible capital. **Intangible capital** comprises organization, franchises, patent rights, and all

other intangible property within the definition of fixed non-landed capital, as above stated. **Tangible capital** comprises structures and equipment having an expectation of life in service of more than one year.

Capital is also divisible into original capital, additions and betterments, as defined below:

Original capital is that put into service at the outset of an enterprise.

Additions include additional structures, facilities and units of equipment not taking the place of anything previously existing.

Betterments include the enlargement or improvement, giving greater capacity to existing structures, facilities, and units of equipment.

By revenues, are meant all amounts of money, which the corporation receives, or becomes lawfully entitled to recover for services rendered, for products sold, as gross profits on merchandise sold, or as a return upon its property, (or interests in property). Revenues are classified as operating revenues and non-operating revenues.

Operating revenues are those derived from the sale of products and merchandise, from services rendered, and from returns on property used by the person or corporation in its own operations.

Non-operating revenues are those derived as a return upon the property of the corporation in the hands of others or from interests in property in the hands of others. They may be sub-classified as rents, interest, dividends and miscellaneous.

Divisional revenues are those derived from the sale of products, services rendered, gross profits on merchandise sold, or returns on property (or interests in property), within the divisions or districts.

Gas Department revenue includes all revenue derived from the sale of gas for light, heat or power.

PUBLICITY A PARTNERSHIP.

BY R. B. MATEER.

Many central stations claim to believe in publicity, and each year endow liberally the leading journals of their cities in order that talks bearing on rates, franchises and regulations may appear side by side with reading notices, attempting in this manner to ward off hostile attacks that threaten the status of a public utility. Thus they endeavor to promote the political welfare of the corporation, but fail entirely to enlist the co-operation of the public by evading the spirit of partnership necessary for the successful operation of public utilities.

Capital cannot regard itself as the principal or sole partner. Labor and the public control the majority of the stock of any corporation, determined to conduct a successful business on modern principles, unhampered with the agitation and baiting which only results in extraordinary and unwarranted expense to all concerned.

The average corporation, with great possibilities for commercial development and capable of large earning power, passes through a period of hardship caused entirely by the capitalist, the promoter usurping sole authority, to the exclusion of labor and the public. Unearned dividends are demanded that stock given as a bonus for promotion purposes may possess a fictitious value and be unloaded on the most important member of the partnership—the public. Failure to recognize the fundamental principals of partnership results in the uneven distribution of the burden and spells ruin.

For the partnership to be harmonious, each must live and work with the other, respecting their rights that proper administration and publicity of a practical character be assured, resulting in winning the confidence and good-will of all consumers.

The public must learn that operating expenses and returns on investment must be derived from earnings; that rates must be fixed to return a reasonable sum on the investment actually placed in the property. Convince the public of a square deal and it willingly pays the charge demanded for service rendered.

Bearing in mind the partnership, it follows that publicity demanded is not that of a political character, but such as places before the eye data on actual operating conditions.

This Fellow Exhibits One Method of Publicity, but Hardly of That Kind Which Will Enlist the Partnership of an Energetic Community.

The miller desires the kilowatt hour consumption per barrel of flour and its cost of production. The foundry accountant is interested in the current necessary to mould and finish a ton of castings. The wirecloth manufacturer is interested in the energy and its equivalent in cash per yard of finished product. The farmer, bent in intensive cultivation, figures on the outlay per season per acre foot of water. The dairyman, first driven by necessity to manual labor, later through economy of operation to steam and its auxiliary machinery, is readily converted to electric power, when the cost of separating his cream or the outlay per 100 pounds of butter is available.

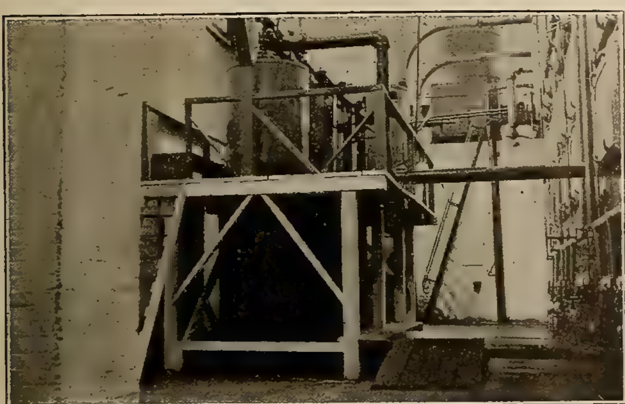
Data based on unit costs, published in the daily paper and accompanied with illustrations, will be an improvement over the general statements now found in print. Attractive folders mailed to the prospective customer, followed with energetic solicitation, is productive of the greatest returns per dollar outlay and promotes the interests of those forming the triune partnership. Publicity, otherwise termed co-operation, is productive of high efficiency, and is the direct evidence of a working agreement among partners, capital, labor and public.

SCIENTIFIC PLANT MANAGEMENT

TESTING. VI.

BY C. R. DELANEY.

It is customary to purchase machinery on the basis of certain guaranteed performances, and in order to find out whether these guarantees have been met, it is necessary to test the various machines after their installation. The test of the plant consists in weighing all water used for steaming purposes and all the fuel oil and making careful measurements of the kilowatts generated, by means of calibrated wattmeters, at the same time taking observations of temperature, pressure, drafts, etc. It is then a simple matter to calculate the pounds of water used by the turbine per kilowatt hour and the pounds evaporated by the boilers per pound of fuel oil, from which the efficiencies can be calculated. In testing the turbines it is usually



Arrangement of Tanks and Scales for Weighing Water in Steam Turbine Testing.

impossible to have all the conditions exactly the same as specified in the contract. For instance, the degree of superheat may be a little less than called for or the vacuum may run a little higher than called for in the guarantee, and it is necessary to make careful corrections to allow for these variations. It is also of great importance to make any corrections that may be necessary due to inaccuracies of the measuring instruments. The steam gauge must be carefully tested and compared with a standard gauge. A correction must be made for the exposed stem of the superheater thermometer. Thermometers are usually calibrated with the entire thermometer immersed at the time of calibration. In actual use there is always part of the stem of the thermometer exposed to the temperature of the room, and if the proper correction is not made for this, the thermometer may read 6 or 7 degrees lower than the actual temperature of the superheated steam. Corrections on the vacuum gauge are of still greater importance owing to the very great effect of a small variation in the vacuum. The barometer must be carefully observed, and its temperature and that of the mercury vacuum gauge must be noted. In all engineering work, a 30 in. barometer is used as a standard and the mean atmospheric pressure taken is 14.7 lbs. A mercury column 30 in. high is correct for a pressure of 14.7 lbs. only when the temperature of the mercury is 58.4 degrees, or say approximately 60 degrees. If a test is made in which the vacuum is measured by means of a mercury column close to the turbine, the temperature of the mercury in this column may be as high as 90 or 100 degrees and if the barometer reading is obtained from the Weather Bureau, who base all their observations on a temperature of 32 degrees, it will be necessary to correct both the barometer and the vacuum gauge to 60 degrees in order to obtain the true vacuum in the condenser. Failure to properly correct for temperature of the mercury columns sometimes means an error of .1 or .15 of an inch of vacuum, which would cause as much error as a mistake in weighing the water of 1200 or 1800 lbs. an hour. It is obvious, therefore, that it is useless to go to the expense of weighing the water, unless great care is taken in making all the observations. After a turbine has once been tested at its maximum capacity, its operation can be checked from time to time by allowing it to carry its maximum load. Owing to the fact that only a limited quantity of steam can pass through the nozzles of the turbine, it is obvious that if the machine is able to carry as great a load as the maximum obtained during the test, it is still operating at practically the same efficiency.

Fuel Oil.

In closing I would like to say a few words in regard to the immense advantage that we have on the Pacific Coast on account of the availability of oil fuel. A plant that is operated with oil fuel costs considerably less to build than a coal fired plant, owing to the fact that no stokers are required, no coal handling nor ash handling machinery have to be installed, and less draft is needed so that the smokestacks can be smaller and lower. Furthermore, much higher efficiency can be obtained with oil than with coal. It is possible to evaporate 15 lbs. of water per pound of oil, whereas with the character of coal available on the Pacific Coast, we could not expect an evaporation of over 7½ lbs. One lb. of oil, therefore, is equivalent to 2 lbs. of coal, so that 1000 lbs. of oil or 3 barrels, is equivalent to one ton of coal. At 80c a barrel, the 3 barrels cost us $2.40, and while it is possible to secure good coal in some Eastern cities at $2 or $2.50 per ton, the price of coal on the Pacific Coast runs as high as $8 or $10 per ton. Furthermore a very great saving in labor is effected by the use of oil fuel, so that it is safe to say that it does not cost us over one-third as much to operate our plants, as it would cost us if we had to depend on coal as fuel. The high extent to which boilers can be forced when burning oil, and the ease with which fires can be started up and stopped make oil an ideal fuel for use in a station that is operated as an auxiliary to a transmission system.

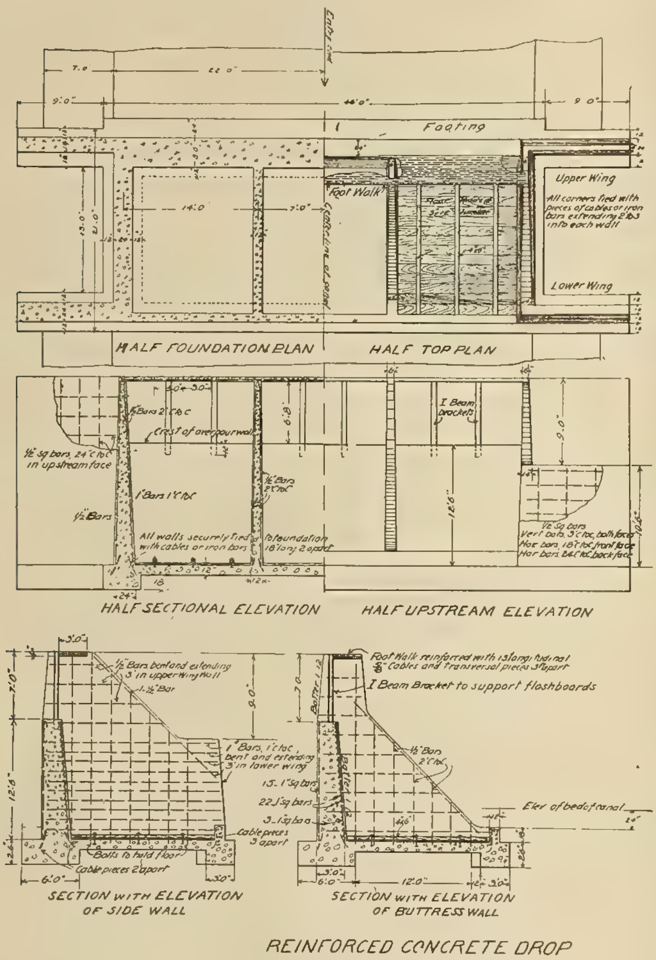
ELECTRICAL PUMPING AND IRRIGATION

IMPACT AND EROSION OF FALLING WATER.

BY B. A. ETCHEVERRY.

Downstream Impact and Erosion of Falling Water.—With notched drops this action is much decreased, the water being discharged in a fan-like shape. Three methods are used to resist this action: (a) By means of a strong floor; (b) by means of a water cushion; (c) by means of gratings or a baffle wall to break up the force of the falling water. These methods are generally used in combination.

(a) Floor of Falls.—The floor is generally protected by a water cushion. The thickness will depend on the character of the foundation, the depth of water cushion, the height of fall and the material used. Wood will resist impact and erosion better than concrete, especially when the water carries sand or gravel, and a wooden floor bolted to a concrete floor can be used to protect the concrete. The thickness of a concrete floor protected with a wooden floor or a water cushion should be made one-tenth of the height of fall, but not less than one foot. The length of the floor when no water cushion is used should be not less than three times the height of fall.



Typical Details of Concrete Drop.

(b) Water Cushion.—The water cushion may be formed either as a depressed basin below the bed of the canal or as an elevated basin about the bed of the canal. The first method is generally used. To prevent eddies at the outlet of the basin the downstream half of the floor of the basin is sloped upstream. The depth of the water cushion is generally about one-third of the height of fall, and the length is made such that the falling water will strike at about the center of the basin. Beyond the downstream edge of the basin the floor should extend a distance equal to about one-half the length of the water cushion.

(c) Gratings and Baffle Wall.—Gratings or a baffle wall placed above the floor in the path of the falling sheet of water have been used to break up the force of impact. But the extra expense can better be applied to the construction of a good water cushion.

(d) Erosion Caused by Eddies at the Downstream end of the Floor.—Eddies occur when the channel formed by the side walls of the drop is smaller than the canal section, so that there is a change from a higher to a lower velocity. To prevent this erosion it is preferable to make the width of the channel formed by the side walls equal to the average width of the canal. For this reason it is often preferable to use either a raised crest or notches instead of a contracted length of breast wall. Where it is necessary to change from a contracted channel to the canal section, warped wings will give better results.

Design of Falls.—The parts of a fall are:

1. The breast wall.
2. The upstream floor.
3. The downstream floor and water cushion.
4. The side walls and wing walls.
5. The upstream and downstream cut-off walls.

The Breast Wall.—The breast wall is usually designed as a retaining wall, but for narrow drops can often be more economically designed either as a slab supported by the side walls or as a slab supported by the floor at one end and a beam forming the crest of the wall at the upper end. When a raised crest is used it is desirable to be able to drain the water held back by the crest, for this water will increase the waterlogging of adjacent land. This is done by either providing drain holes in the crest at the level of the bed of the canal or by making at least a portion of the crest removable or adjustable by means of flashboards or gates. For a notched crest the principles discussed above must be followed.

The Upstream Floor.—The length of the upstream floor is generally short, and often the floor is entirely omitted.

The Downstream Floor and Water Cushion.—These have been previously discussed. They must often be supplemented by an extension of riprap or paving.

The Side Walls and Wing Walls.—The upstream wings prevent the water from washing around the structure. They should extend well into the banks.

They may be placed at right angles to the axis of the canal or may form an angle of 30 to 45 degrees with this axis or may be warped surfaces. For an equal quantity of material a right angle wing will run further back in the canal bank. A warped wing or a wing placed on an angle guides the flow into the inlet, while a right angle wing will partly check the flow of water. This, however, is not objectionable in a drop. The side walls and downstream wings should guide the water in a straight course and prevent irregular currents. They also hold up the banks, and should protect the downstream banks from erosion. This is best obtained by making the distance between side walls on the downstream side of the breast wall equal to the average width of the canal and by extending the downstream wings well into the banks. The wing walls have earth pressure on both side. These pressures are usually unequal, but to a certain degree counteract each other so that the walls need not be heavy. The side walls, especially for high falls, resist high pressure and are designed as retaining walls.

Upstream and Downstream Cut-Off Walls.—The upstream cut-off wall is placed at the upper edge of the upstream floor, and is in the same line as the wing walls when right angle wings are used. It should extend below the bed of the canal to a depth of at least one-half the depth of water in the canal for ordinary soil, and deeper for very open soil. The downstream cut-off wall is placed at the lower edge of the downstream floor, and a depth equal to one-half that of the upstream wall is sufficient. Typical plans of drops are shown in the accompanying sketches.

Modesto Reinforced Drop.—The total fall is 11 feet, which is increased when flashboards are inserted at the crest. With the flashboards the structure can also be used as a check gate. The width of the structure between side walls is about the same as the bottom width of the canal. Between the side walls two piers or buttress walls divide the drop into three parts. Resting on these piers is a foot walk 3 feet wide and 4 inches thick, reinforced with 13 lengths of old ⅝-inch cable. Between the piers are 4-inch eye beam brackets to support the flashboards. These eye beams have the lower end imbedded in the concrete crest for 12 inches and the upper end bolted to the foot walk with two bolts imbedded in concrete. The buttress walls and eye beams divide the space above the crest into openings 4 feet 8 inches wide, regulated by means of flashboards.

To resist the erosive action of the water at the foot of the drop a shallow water cushion is formed by a toe wall 1 foot high; the crest of this toe wall is about 2 feet below grade, so that the actual depth of water cushion is about 3 feet. In addition a wooden floor is bolted to the concrete floor. This wooden cushion has proved very efficient, wood resisting erosion better than concrete. The wing walls above and below the drop run back at right angles to the axis of the structure, into the banks, acting as cut-off walls.

In building this structure the footings, foundation and floor were first constructed. Then the side walls, crest wall and wing walls were constructed. These walls were all tied to the foundation by means of pieces of old cable and steel from 18 inches to 3 feet long, spaced about 18 inches apart in double rows; one for each side of the wall and extending into the foundation at least nine or ten inches. All walls are reinforced with square steel bars. The corners are securely tied by pieces extending two or three feet in

Reinforced Concrete Drop, Modesto Irrigation District, California.

each wall. After the concrete was put in place the structure was very carefully puddled by holding water above the lower cut-off wall and puddling carefully while filling with the excavated material. The cost of building this structure was as follows:

Excavation	$ 151.50
Gravel (including hauling)	280.00
Cobbles (including hauling)	170.65
Cement, 205 bbls, at $2.75	563.75
Hauling cement	62.50
Hauling lumber, etc.	150.00
Miscellaneous team work	38.65
Labor—concreting, riprapping	544.45
Labor—building form, placing steel	150.00
Labor—removing forms, plastering	40.00
Puddling	134.10
Storing lumber and outfit	36.00
*All steel (excluding cable)	329.65
Cook house supplies	280.15
Blacksmithing, rods, bolts, shovels	29.25
	$2960.65

*9182 lbs. of corrugated bars, 830 lbs. of steel shapes, 700 lbs. of old steel cable.

Volume of concrete—floor and foundation	86.5 cubic yards
Volume of concrete—superstructure	108.5 cubic yards
	195 cubic yards

Total cost of drop in terms of concrete used = $15.20

ELECRIC STREET RAILWAY CONSTRUCTION IN MEXICO.

The electric street railway now in operation, known as the Ferrocarril Electrico de Lerdo a Torreon S. A., which connects the three most important cities of the Laguna district, viz: Torreon, Gomez Palacio, and Lerdo, maintains several belt lines within the city of Torreon, a total trackage of 30 kilometers (18.6 miles). The manager of this line, Mr. Emilio P. Stein, of Gomez Palacio, Durango, states that the past year has been a most prosperous one and that, in addition to declaring the usual dividend of 12 per cent on the capital stock, there remains a tidy surplus for new construction and for the purchase of new equipment.

PROPOSED ENGINEERING EDUCATIONAL WORK AT THE STATE PRISONS.

BY ROBERT SIBLEY.

Since considerable publicity has been given to the recent inauguration of proposed university extension work in the state prisons, a word or two regarding its present status may not be out of order.

Some weeks back Warden Johnston of the Folsom state penitentiary wrote to President Wheeler an appeal for aid. This appeal was made with particular reference to certain prisoners who wished to better themselves during confinement in order that upon the expiration of their terms they might be of some use to themselves and to the state. As a number of the men have followed trades previous to their confinement they are desirous of improving themselves along such lines as mechanical engineering, structural work, and architectural design and particularly along the trade idea. In order to get a conception of the proposal at close range the writer went to Folsom on March 28th and there had an opportunity of lecturing before the entire eleven hundred prisoners and afterward engaged in personal conversation with some half a hundred convicts. The subject chosen for the lecture was an illustrated talk on The Great Engineering Feats of the West. The men seemed particularly interested in the discussion and many of them afterward told the lecturer that they personally had been engaged at one time upon various phases of the projects discussed.

To many the very mention of the name of Folsom, or of any state penitentiary, connotes the idea of a group of men scarcely human in their make-up, but to see these men as I saw them on last Friday instantly moves one to his very depths. Here one may see young men who have committed crimes in their early twenties after several years of confinement brought to the deepest appreciation and realization of life and its fullest meaning, awaiting only an opportunity to show the state their earnestness of purpose. As Warden Johnston states, it is his earnest aim to endeavor to inspire such men with ambition so that when they leave the prison they are at least no worse than when they entered and indeed by holding out to them an opportunity for improving themselves in spare moments to make useful citizens out of themselves instead of public charges as so often proves the case.

So far as I could judge in the few hours at my disposal none of the men are sufficiently qualified to engage in advance study in any branch of engineering but many of them are fully equipped with the practical side of the trades and indeed in many instances of the engineering professions. These men represent all stages of preparation and practical experience hence no unified course of instruction can possibly be made to apply to them. Here is a splendid opportunity for students in engineering at the university to aid in welfare work of this sort by assisting in individual effort, the proper guiding of the various classes of men. No more repaying work can be found for anyone inclined among welfare work than such opportunies as were shown me during my brief stay at Folsom.

No concrete plan has thus far been evolved even should any funds be available to handle the proposed extension work in the prisons. It would seem to me that the following outline might prove thoroughly practical:

That the prison authorities have some one on the grounds who could act as a local organizer and encourage the various men to help themselves—by helping themselves, I mean that among the prisoners are found men fully capable of helping the less informed. Some one at the university could then work in conjunction with the man upon the ground and encourage certain of the students who desire to engage in welfare work of this nature to take under guidance one or two prisoners and map out work to meet each individual case.

Such a plan would not only attain maximum results with the prisoners but would reflect in giving the student undertaking such work a deeper and more earnest realization of life and could not help but aid him in preparing for his own undertakings in life and at the same time hammer in still further the theoretical training he himself is getting at the university.

Our state prisons are releasing into the state from two to three thousand convicts every decade. That these men should go forth, if possible, with a fuller realization of life and that some hope of some sort may be inspired in their bosoms seems to me one of the greatest problems we have before us and the university will do well through its extension work in meeting this demand in every way possible. With no funds available at the present time it is difficult to plan just how this work may be undertaken, but the opportunity so fully exhibited surely will not be allowed to pass without our stretching forth the helping hand.

MUNICIPALLY OWNED STREET CAR SYSTEM IN AUSTRALIA.

At a special election on January 15, 1913, the citizens of Hobart decided to purchase the tramways (street car system) for $1,050,000. The vote favoring the proposition was about 4 to 1. The system includes a power plant and about 8 miles of track, which is limited to three lines running to three different parts of the city. The rolling stock consists of 28 double-deck cars, which cost $4000 each. It is the intention of the municipal council to make several extensions and improve the service generally. The old-style cars will be discarded and others of a more modern pattern substituted. The steam railways in Tasmania are already owned and operated by the state.

MEXICAN PETROLEUM OUTPUT.

The development of Mexico's petroleum industry is shown by the following statistics of output of crude oil in the past six years:

	Barrels.
1907	1,000,000
1908	3,481,410
1909	2,488,742
1910	3,332,807
1911	14,051,643
1912	16,500,000
Total	40,854,602

RAILWAY MOTOR AND CONTROL EQUIPMENT.[1]

BY A. A. MILLER.

It is a safe prediction that in the next ten years of our history remarkable results in the way of railway electrification will be accomplished and before many years electric railroading will be as prevalent as steam railroading is now. The steam locomotive will be supplanted by the electric just as effectively as the horse is by the self propelled vehicle. Every indications points in that direction. Money for electrification will be readily forthcoming—not in a rush, it is true, but in a gradual, dignified and irresistable manner—as certainly as the mark of time. And the key to the whole situation is efficiency of operation. We are all on the qui vive nowadays when anyone says "efficiency." The term "efficiency engineering" is one of new coinage brought about by the pressure of the demand for a greater realization of economy. A great many of our present methods in all businesses and professions are inefficient. How can the great element of waste be reduced? This is the burning question. And the railroad man is not the least disturbed individual about this matter. Operating men for the last three years particularly have been studying carefully the cost of operation of rolling stock, and as the result some radical changes in design of equipment and application of motive power have been found necessary. The weight question has received a maximum of attention, and whereas half a dozen years ago found the weight factor scarcely scrutinized, today, on account of it, we are in the midst of a wholesale change in the design of every part of the rolling stock. The efficiency of design of a motor car for city and suburban service is now judged largely by the net weight per seated passenger. Six hundred to seven hundred pounds per seated passenger are now considered about the best obtainable, and this figure has been realized by cutting out every pound of unnecessary material. Previous to this crusade against useless weight, we were quite satisfied with a thousand pounds and more per seated passenger. A comparison of the figures given readily shows what has been accomplished in the right direction. All steel construction for car bodies and the careful study of stress diagrams have produced structures surprisingly light considering the stiffness and rigidity obtained, which are much greater than were thought possible; the consequent resistance to crushing by the heavy impacts of collision and other accidents renders personal injury to the traveling public much less liable with resulting economy to the operating companies both by diminution of damage suit settlements and by lengthening the life of the car body—two points of primary importance.

Trucks, axles and wheels have all been carefully gone over to reduce weight as much as is consistent with required strength and a reasonable maintenance cost.

[1] A paper read before the Seattle Section of the A. I. E. E., February 18, 1913.

The last part of the equipment to receive attention of operators on the score of weight were the motors, and the question of whether or not a light weight motor is most economical has received especial attention.

An excellent contribution to the literature on this subject was made not long ago by Mr. F. E. Wynne, consisting of a paper read before the Baltimore Section of the A. I. E. E., entitled "Economies of Railway Operation." This appeared in the Institute Proceedings and is worthy of close study by those particularly interested. Mr. Wynne shows conclusively that to cut the weight of the motor equipment any considerable amount below that of standard types, that have existed for several years past; means a serious step in the wrong direction, as a light weight motor necessarily means one of high armature speed with resulting loss of power economy. A waste of power brought about by this means results in increased cost of operation. A careful series of tests have shown that the greater power saving obtained by a moderate speed motor (although it weighs somewhat more than the motor having a high inherent armature speed) was worth in that case more than twice as much as the cost of carrying around the excess weight of that motor. The fact was thus realized that little improvement in total weight can be effected by reducing the weight of the motor equipment.

One result of this realization has been the development of field control of railway motors and by this means surprisingly beneficial results have been obtained. Field control is not a new idea. On the contrary it was tried out years ago, but due to the commutation difficulties it engendered, it was necessarily abandoned and has lain dormant until the development of commutating pole railway motors with the attendant excellence of commutation under most severe and adverse conditions of service has again brought it to the front and rendered it a most practical method of obtaining a degree of flexibility not otherwise obtainable.

There are two methods of obtaining field control, one is by shunting the field winding with a non-inductive circuit and the other by cutting out a portion of the field winding. The latter method is the better one as it reduces liability of flashing at the commutator. Two field strengths are thus obtained with this method and two characteristic speed curves are secured, that with full field being lower than that with normal field. The torque per ampere is naturally higher with full field than with reduced field strength, and the current required in acceleration is correspondingly reduced. On all excepting the last series and the last parallel notch of the controller the motors operate with full field and are on resistance points. Both series and multiple running positions are, therefore, with reduced field and the motors operate on the higher speed characteristic. Note that the rheostatic losses are reduced on account of the accelerating current being cut down by the higher

torque derived with full field. Two ideal results are thus obtained with the same motor equipment (it should be noted these results cannot otherwise be secured)—first, most economical acceleration the same as would be obtained by using a slow speed motor and, second, high speed operation without gear ratio difficulties; in other words, the same effects are obtained as if an ordinary inherently slow speed motor were equipped with two gear ratios, one to give the highest tractive effort at the wheel tread in starting, with minimum current, and the other (a lower reduction) to be used for higher speed after the peak of the accelerating current had died away. Such a combination is, of course, only theoretically possible, as no serious attempt has ever been made (at least to the writer's knowledge) to effect a gear change on an electric car similar to the gear shifting mechanism of an automobile.

The use of a slow speed motor instead of a high speed motor in the example shown by Mr. Wynne reduced power consumption 10.9 per cent while the use of a slow speed motor and field control produces a saving of 19.5 per cent. This is largely on account of the fact that the resistance is all cut with the field control motor at a lower speed point (hence earlier in the acceleration) than it is with a slow speed motor not using field control.

The development of the commutating pole railway motor has been one of the most valuable events in electric railway history. It is claimed by some that the development of a motor ventilated by means of a fan on the end of the armature is an equal contribution to the art, but this is a badly exaggerated view as the standard motors of at least one American manufacturer have been well and sufficiently ventilated by the induced draught system for years past, which was accepted as a matter of course. No new principle was evolved, and, in fact, not even a new application of an old principle was made by putting a fan on the rear end of the motor armature thereby causing a longitudinal ventilation of the armature, but it has been so proclaimed. Exactly the same results had been secured for years past as is vouched for by the fact that the motors employing the same old ventilation method are guaranteed to perform the same service with the same temperature rise.

The old contention between d.c. and single-phase railway systems has fortunately subsided. It is a matter of history, a sort of reformation period. The single-phase system has gone and is still going steadily forward. It has come to stay and one cause of the subsidence of the controversy is this very fact. The use of a single-phase apparatus has not wrecked any road financially, where properly constructed and intelligently applied. We shall see larger and more important applications of it in the near future than we have in the past. The system of the New York, New Haven & Hartford Railway is a monument to the perseverance and skill of the engineers who designed, executed and operated the apparatus involved. Before long single-phase locomotives will pull trains all the way from New York to Boston on one of the most important railway systems in the world. The word failure is not in the vocabulary of single-phase terms.

ELECTRIC WELDING.[1]

BY W. M. PRICE.

Electric welding, so called, is the name given to the various processes whereby metals are so heated that their molecules can unite and form more or less perfect unions, either with their own kind or those of different metals. It is seen from this that electricity itself has no effect on the metal other than to heat it, and consequently the joints made with its aid are no different from those made with other heating methods with the exception that in some of the variations of electric work it is possible to eliminate oxides from the uniting particles and thereby make a more perfect joint than is possible with other heating mediums. This question is often asked by those unfamiliar with the facts.

All metals can be united by one or the other of the electric processes, although not any one process is capable of uniting all metals. Various sizes and shapes of similar or dissimilar metals can be united with the same limitations.

The metal forming the joints can be of the same kind and quality as that of the main pieces or it can be harder or softer or of different kind, as may be required. This work also has the limitations of the various processes.

Joints have a strength which is dependent on the process used, the filling metal if used, the original joining metal, and, to a certain extent, the amount of time used in doing the work and in the arc systems, the skill of the operator. This strength varies from 30 per cent with poor work to 90 to 95 per cent with the same area joined as the original pieces. If it is allowable to have additional area of joint with additional metal put on, the strength of joint will be over unity.

By means of the arc systems the work is not confined to making of joints only. Additional metal can be placed where weaknesses are shown, faults in castings repaired or missing portions made in place, worn or thin places built up, etc. The metal added can be, as stated before, of the same or different quality from the original pieces. It will be seen from this that worn places can be made better than the new by the addition of harder metal. New hard metal can be put on soft where the design of machinery requires it. Flat spots on car wheels can be repaired without grinding down the wheel other than to finish the repair, etc.

Electric welding is divided into two general forms, and each of these into several. The general forms are those of arc heating and resistance heating. The arc doing its work through the heat developed by a moderate amperage carried across the gap by a voltage of 60 to 125, the resistance doing its work by the heat developed by large amperage carried through the joining metals by means of low voltage. The arc systems are usually operated by direct current, and the resistance by alternating, although there is no reason that direct could not be used in the latter if it were not for the enormous current required at a very low voltage which would put the system out of commercial use if it were not for the fact that the alternating current can be readily changed to the required amperage and pressure. Owing to the difference in the heat of the

[1]A paper presented at the Seattle Section, A. I. E. E., January 18, 1913.

positive and negative arcs craters, the direct current gives the better results in many cases, although the alternating can be used.

Arc welding is the earliest of the various forms and dates, by patent record, from 1885 (No. 363,320, Bernados and Olzewski), although there was considerable experimenting done prior to this date. There was little practical work done by the earlier experimenters, due to their lack of knowledge of how to treat metals at the high temperatures generated by the electric arc. These experimenters took out patents on schemes designed to overcome their difficulties, these schemes being such as mechanical movement of the electrodes to prevent burning of the metal, working in vacuum, various compounds of materials used for fluxes, etc. The proposition has, however, gradually simmered down to a matter of skill of the operator, with his knowledge of the proper filling metal to use, and the working of this metal, the proper pressure and quantity of current, etc.

The three systems are nominally known under the names of those that were prominent in the early experimentation, or who took out the patents thereon. These are the Bernados, Slavinoff and Zeriner.

The Bernados system is that using a carbon as one electrode and the metal being worked on as the other, drawing the arc between. The voltage is usually 100 and the amperage dependent on the work that is being done, and varies from 25 to several hundred for use in heavy foundry work. In this process the operator, equipped with a hood over the head, and containing heavy colored glasses, through which to see, and which are to protect the eyes from the intense light, holds one terminal of the generator supply cable and to which is attached the handle of the carbon clamp. This is done with one hand and the other holds rods of filling metals, which are to be melted and joined with the pieces being repaired. The repair work is placed on a metal-topped table, which forms the other generator terminal. The arc is struck between the carbon and the work, and the heat of the arc melts the metal and the particles run together. As it is very seldom hammered, the nature of the weld is more like that of a casting. This process is very easy to learn to operate, and can be done by unskilled labor to a certain extent. This is the process that is also used as a cutting agency, although now being replaced by the oxyacetylene burners. This process can be used to do any work that is capable of being laid below the arc so that the melted metal of the work can unite with the metal of the rods used to fill holes and spaces and melted by being held in the arc.

The defects of the Bernados system are that it can be only worked on horizontal repairs, is very liable to make hard spots in the metal and due to the carbon of the electrode combining with the melted metal, and these hard spots are often too hard to machine, and due to the casting form of work the area highly heated is large and shrinkage strains are set up that cause future breaks unless the metal is of such form that it can take up without strain.

An improvement on the Bernados system was patented by Slavinoff in 1890, in which a metal rod was used in place of the carbon, thereby overcoming the objections to the hardness of the joint, and also making it possible to make joints and additions of the metal that is wanted. This was a very great improvement, and it was found that a reduction in the voltage and amperage also overcame the difficulties of strains as the local heating was materially reduced. Owing to the skill that is required in this process, however, it had very little commercial use until the last few years, when various experimenters took up the work and showed that it had value in certain classes of work. This system is the only one of the arc systems that allows of doing work whatever its location. For this reason it is almost as easy to do work over one's head as beneath his hand. As the work done by this system is usually of skilled labor, the quality of the joints is high, and 75 to 90 per cent is common strength. This is the system that is used for building up worn places, replacing missing parts, repair of boilers, tanks, etc. It can be used on any metal.

The third and last arc system is that known as the Zeriner, and also goes under the name of the electric torch. In this there are two carbon electrodes carried in a frame, in which is mounted a magnet, which is used to blow the arc down on the work, over which the torch is held. The heat of the arc does the work in the same manner as does the Bernados. Owing to the weight of the apparatus, it is only practical for small current capacities, and for light-weight metal, and has been almost entirely superceded by the O. A. burners.

It will be seen from the description of the arc systems that each piece of work is a separate proposition, and to be separately worked on, and quantity cuts very little figure. In the resistance systems, on the contrary, it will be noted that the work is done by machines. and that these are best adapted to certain forms, and consequently quantity of work of one kind is a requisite.

There are two forms of the resistance system—the butt and the spot. The butt welder is a machine that embodies a transformer which has its low pressure terminals connected to the two pairs of jaws of two vises, which are arranged with one stationary and the other movable toward the stationary one. The jaws are of copper and water-cooled in all of the larger machines, in order to take away the heat due to the resistance of the joint between the jaws and the metal therein held. The two pieces of work, being fastened in the vise jaws, are pressed together, and the current turned onto the primary of the transformer. In a few seconds the joint is hot enough to allow of being closed up by means of pressure applied to the movable vise. The current is cut off and the work is ready to be finished under a hammer, and which finishing is usually necessary to get rid of the fins. The primary voltage of the transformer can be made of any value; the secondary is usually 4 to 6. The wattage depends on the size of the work, a ¼-in. rod requiring about 3 kw. for three seconds' application, a 1-in. rod 30 kw. for 20 seconds and a 2-in. rod 75 kw. for 45 seconds. The strength of joint made with this type of machine depends on the metal that is joined. Low carbon steels, iron, etc., show up very well with 85 to 95 per cent strong joints. Special steels do not do as well, although this system will weld them better than any other.

In butt welding it is imperative that the area of the joining surfaces be the same or that the larger be

preheated, so that when the current flows the two will come to the welding heat at the same time. If this is not done the smaller will be always burnt and the joint of little value.

The other form of the heat welder is that known as the "spot welder," in which the same scheme of large current and low voltage is used (although the voltage in this machine is usually slightly higher on account of the higher resistance off the joints) and the weld caused through the heating, due to the large current. In this case the current is led to the metals through copper tips, likewise water-cooled, and when the metal is sufficiently softened is pressed together, thereby forming a weld. Owing to the amount of pressure being comparatively small and the copper points of small area, this system is not adapted to very heavy work, and is usually used on material of sheet form of ¼-in. and less in thickness, although there are machines that will do 1 in. with good results. The strength of the spot welded joint is greater than a rivet of equal area, and has the advantage that there is no hole-cutting or punching, and is done in much less time. The time required on No. 10 metal is 1:5 seconds with a power demand of 20 kw. The machine is best adapted to manufacturing work, but is better adapted to jobbing than is the butt welder.

There is another form of the heat welder that is seldom seen, as there are difficulties in its use that limit it strictly to manufacturing. This is the seam welder, where the current is led to two copper wheels that travel along the joint, and make the weld in the same manner as does the spot welder. This is only adapted to light gauge sheet metal that has been well cleaned of scale. It is used in putting coffee spouts in place and other similar work.

There are various adaptations of the resistance welding machines, and each machine adapted to special work. For instance, there is a machine that is used to make the joints in kitchen boilers and requiring about 1¼ minutes to do the work. There are a number of forms of machines for making various kinds of chains and links. Wagon axles are made of three pieces of metal, two round for the wheels and the other square of larger area and joining them. This is often done in a welder, and reducing the cost materially. Twist drills are made of two pieces of metal, one fluted and the other plain. The two joined make the cutting portion of the drill and the other the shank. In this work the cutting edge is often of better material than the shank. Taps are made the same way. Those of you who have autos will find that your mudguards are spot welded to the frames that support them, etc.

From the standpoint of the station man electric welding is not of very great value, nor will it bring in much income. This is due to the low load factor of all of the systems and the lower power factor of the butt and spot welders. The Bernados arc system is perhaps the best for the power man, as its demand is fairly steady when in actual use. The Slavinoff is very intermittent on all work requiring maximum strength of work. The Zeriner would be good if it were in use. The butt and spot welders have such a small time use of the current and low power factor that they are not satisfactory load. The power factor is from 65 to 75 per cent. The demands depend on the areas of the joints.

There is one form of what might be called an electric welder, although the actual joint is made on an anvil. This is the Burton electric forge, patented in 1897. In this the metals are put into a tank filled with a soda solution, and the current carried through the metals. The heat of the hydrogen gas liberated and burnt soon brings them to a working heat, and they are then taken to the anvil and worked as required. The small amount of data obtainable shows that 6 kw. d. c. require 1 minute to heat a 1-in. square rod; a ¼-in. section rod was heated in eight seconds.

Costs of welding by electricity are very much lower than by any other system, that of the arc being the most expensive, owing to the skill that is required and the wages of the operators. It can be done with equal strength at about half the cost of gas welding. Butt welding and spot welding can be done in any kind of quantity at from 5 to 15 per cent of the cost done in any other way, provided that the work is of the class that can be well done by the method used.

SOME FUNDAMENTAL PRINCIPLES IN TELEPHONE PLANT DESIGN.[1]

BY A. H. GRISWOLD.[2]

The fundamental principles on which telephone plants are designed are, first—to provide satisfactory communication between individuals separated by a definite distance, and second—to provide this satisfactory transmission at a minimum ultimate cost.

A telephone plant may roughly be divided into two broad parts—the long distance lines or the toll system, and the local or exchange system. The design of the toll system as far as physical construction is concerned does not differ materially from the design of any pole line carrying any other utility, except in so far as the telephone transmission is concerned. This problem of transmission is one of the most difficult in the telephone art, and is in itself a considerable problem. Accordingly, I will confine my remarks to the design of local or exchange plants and attempt to give you only some of the basic principles involved.

There is in any city a fairly definite relation between the population and the number of telephone subscribers, and such a ratio will be found to hold fairly constant with probably a slight continuing increase. Therefore, in laying out a telephone plant, the first thing to determine is the population. This is obtained from past census reports and accurately plotted and extended about 15 years hence, taking into consideration the reasons why the city might or might not grow at a faster rate or slower rate than it has done in the past. As a check, commercial bodies, city officials, officers of other corporations and representative citizens, are interviewed and their opinions obtained. It is probably needless to state that, if a correct answer is desired, it is generally necessary to discount their estimates by a considerable amount. Against this curve of population there is plotted a corresponding curve of growth of telephone subscribers. In this manner a very reasonable forecast of the future devel-

[1]Paper read before the San Francisco Electrical Development and Jovian League.
[2]Plant engineer of the Pacific Telephone & Telegraph Co.

opment at various future periods is obtained. A map of the city is then taken, and on this map is placed the estimated location of the subscribers in about fifteen years. A fifteen year period is used because this is the average life for the principal portions of the plant, and it is as far ahead as conditions can be reasonably predicted. In making this estimate, it is, of course, necessary to study very carefully each section, each block and often each house or building, and make the best possible forecast as to what kind of business will ultimately be required. In other words, the present and future possibilities are considered. If a manufacturing section is being considered, it will be determined probably that comparatively few telephone lines will be required, there simply being a few trunk lines from some telephone central office to large private branch exchanges. On the other hand, if it is a block in which there are or probably will be located large office buildings, a very high telephone development may be expected. In the same manner, in considering residence districts, the character of the district and of the houses is considered, it being generally known that the larger and better areas use individual lines, while the cheaper areas use party lines almost exclusively.

Having plotted the location of these subscribers, the next point to be considered is the wire center. By wire center I mean the point at which, if the office is located there, the average length of a subscriber line from the central office to the subscribers station will be a minimum. This wire center will sometimes fall in the heart of the business district, due to the generally heavy telephone development in that area. Real estate at reasonable prices is, therefore, not always obtainable at the wire center, and accordingly it may prove more economical to establish the central office a little off the wire center rather than to pay an excessive amount for the real estate. In other words, the excess cost of the real estate must be balanced against the distortion in the wire plant. This, of course, can be and is equated in dollars and cents.

We have thus far determined the location of the subscribers within each block, and from that, the location of the wire center or central office. The next point is the consideration of how to bring the subscribers into the central office at a minimum cost. Obviously, it is more economical to carry one large cable from the central office out to a certain district and distribute from the cable to the various subscribers, rather than to bring an individual pair of wires from each subscriber into the central office. The physical conditions encountered in the city, the character of the streets, whether paved or unpaved, etc., are considered, and main backbone routes, providing always a minimum distance to the central office, are established, and a map, or what is termed a fundamental plan, drawn showing these various routes all centering at the wire center or central office. This fundamental plan furnishes the general basis for a continually efficient construction program for any exchange area so that each step may be based upon the most complete possible understanding of all the available data and the possibilities involved. Whenever any important construction or reconstruction work is undertaken, it is necessary to decide certain questions for which a fundamental plan gives the best information, and if a satisfactory plan is not available it is necessary to base the decision on some of these questions upon an incomplete understanding of the factors and a considerable amount of pure conjecture. Fundamental plans are also necessary as a guidance to prevent the adoption of plant or traffic methods which will prove unsuited to the conditions of a growing system, and the indications of a fundamental plan are often of assistance in considering certain commercial problems. The answer must cover not only the present condition or a short time estimate of growth, but the probable later conditions in order that temporarily cheaper expedients are not adopted with later large losses, due to the fact that the method chosen is not adapted to the growth of the plant. When a business or legal arrangement is to be entered into, binding the company for a long period to certain rates for certain kinds of service, the telephone company should have as good an indication as possible of the probable number and distribution of future subscribers because these may be so different from the present that a rate which would be remunerative at present would finally produce too small a net return or even a loss. Such questions as these all can be answered intelligently with the help of a fundamental plan, and if such a plan is not made, the answer must be based on incomplete understanding of many of the factors. These fundamental plans are reviewed and brought up-to-date whenever the growth seems to indicate that modifications are necessary. In general, the period for review is once in about every five years.

Some of the uses of these plans are also as follows:

If you had 25 subscribers in a certain area at this time, and 15 years hence you estimated that there would be 100 subscribers within that same area, you would not place a 25 pair cable to feed that area because immediate relief would be necessary, nor would you place a 100 pair cable because that cable would not reach its full efficiency for fifteen years, but knowing the cost of installing cables and knowing fairly well about how that area will grow, you can balance the cost of plant against the growth and determine the economical size and period for the cable to be installed, and very probably you will find that something like a 50 pair cable which will last five years is the economical size.

Again in constructing a central office building, it is economical to build it large enough to care for the equipment for about eight years, and at that time extend the building to care for future periods.

Again in placing equipment in central offices, you ordinarily install enough to last two or three years, and so on for each type of plant.

Therefore, an adequate fundamental plan, together with the estimate of growth of telephones, are used as a guide whenever any important construction is contemplated, and each piece of plant that is added, is placed with a definite end in view and with a knowledge, if the predictions have been carefully made, that it will form a part of the ultimate and economical whole and therefore that minimum ultimate cost will accrue which, of course, is fundamentally essential in the proper design of telephone or any other type of plant.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Convict and his Usefulness in Engineering

To visit any of the great state penitentiaries of the West and to talk individually, one by one, with the unfortunates there confined is to have the human heart-strings touched as perhaps few experience in the usual even-running course of life. But putting aside all matters of sentiment and propounding the question of ultimate welfare to the state, the entire problem is one of serious concern. In central California, for instance, are located two of the world's greatest universities graduating annually some seven hundred students. Approximately to the west and to the east are two state penitentiaries graduating annually some four hundred convicts. The real problem for solution, then, is to bring about the mathematical verity of numbers arranged in proportion of which all are familiar, namely: "The product of the extremes should be equal to the product of the means."

Considered from the standpoint of most vital interest to the state, the problem is not one of pity for the unfortunate convict, nor sympathetic aid to the downcast. It concerns the very well-being of the body politic.

Warden Johnston of the Folsom penitentiary recently appealed to the state university of California in an effort to have some aid extended to such of those convicts as earned by exemplary behavior and general demeanor the privilege of improving their time during spare hours looking toward fitting the convict for some real usefulness when thrown again upon his responsibilities.

It so happened that it fell to the lot of the chief editor of this journal to make the preliminary investigation of the new problem. The details of this experience may be found on another page of this issue.

One of the prisoners in talking to a representative of the San Francisco Bulletin some days later thus described his impressions of this preliminary work:

"Only a few days ago the warden had a professor from the Univeristy of California give us an illustrated lecture on mechanical engineering. It was one of the most interesting things I ever heard. The professor showed viaducts, bridges, culverts, dams and all kinds of structures and pointed out the difficulties surmounted by engineers. I was not only interested in the subject, but when I was thinking about it in my cell that night I thought, 'Why can't you surmount difficulties, too?'

"Do you see the lesson I got?

"The professor offered to send books to any man who wanted to study the subject, and the warden is going to have similar lectures on other interesting and vital things right along."

After the lecture followed a personal, individual chat with some half a hundred men that had manifested a desire to improve their moments of relaxation. An electrician here, a molder there and an inventor yonder indicated in unmistakable sincerity a desire to undergo any sacrifice if only another opportunity in life would present itself whereby he might be given a chance to take his share of the world's burden from a fair start.

In Montana splendid results are being attained in prison reform. Good roads for that state are being built, ambition is inspired in the convict, his usefulness as a possible producer is heightened, and the

general standard of citizenship is consequently being raised.

Under the new system of parole in California some good results are being attained. The greatest object to the state under any scheme inaugurated should be that these men when set at liberty do not go out hardened criminals, or at least do not go out worse than when they entered confinement.

Without ambition or hope in life how can it be expected that these released convicts can become anything but incompetent, lazy, dissipated public charges? No truer saying could ever be held out to the convict than "while there's life there's hope." In the trades allied to the engineering profession thousands of these men could find a profitable and honorable livelihood. Ample opportunity for laboratory practice is available at every prison ground. Such as are ambitious and willing to seek self-improvement at the sacrifice of leisure hours should be given the opportunity. No greater welfare work for the state is possible than this, and on the other hand no more appreciative service that touches the heart through and through could ever be attempted.

Considered from the business standpoint, from the view of greatest good to the state, divorcing all possible benefit individually to the convict the helping, uplifting hand sent by western state authorities to their state prisoners could not be exerted in a worthier cause. In this helping attitude, engineering and the kindred trades will undoubtedly offer a valuable aid.

Wanted: Slogan for Electrical Development

Two great qualities of sound have through all ages thrilled and moved mankind to action. The first, music, when played in martial strains has urged men forward upon the field of battle even in the face of instant death, and when gasping for final breath of life the plaintive strain of a mother's evening hymn, "Home, Sweet Home," heard in memory's vision, has called the warrior once again to life and action. The slogan or battle-cry, too, has ever, from the earliest dawn of history, played a dramatic role in the rise and fall of human accomplishment. The West and her traditions are closely interlinked with the persevering cry of the hardy pioneer, "do or die," "Pike's Peak or bust," and countless other stirring war cries of the forty-niner.

Today a great commercial struggle is upon us. The gigantic growth of the electrical industry bids well to sweep everything before it. Indeed, its grim and determined backers have decreed that it must. Years ago philosophers meditated over the profound subject: "What's in a name?" and even Shakespeare or some other notable writer on human character, propounded the time-honored saying, "give a dog a bad name and you may as well kill him."

It is not a dog that is to be named this time, however, but an organization whose subtle force is so all powerful that the ancients reversed the spelling and called it a god for whose name and attribute we now search.

There is wanted by the Society for Electrical Development, Inc., some trade mark and slogan, or, if you please, a war cry by which this young giant of recent creation may sweep everything before it.

A cash prize of two hundred dollars for suggesting such a trade mark and slogan for popularizing the national use of electricity has been offered by this society. An attempt to win this prize is indeed worthy of thoughtful consideration by our best and brightest engineering intellects. Suggestions should be marked "Slogan Contest" and addressed to The Society for Electrical Development, Inc., 29 West 39th street, New York.

Many different types of slogans will undoubtedly be suggested. An emblem, typifying at a glance the greatest purposes of the society with an inscription below, significant of the campaign to popularize electricity may prove a prize winner.

To move men to action, to drive the business home, we must, however, have a slogan that immediately catches the fancy of the layman, enthusing and overcoming every obstacle such, for instance, as the now much hackneyed expression, "you push the button, electricity does the rest."

The fortunes and results of this new thought of organized electrical development will reach and be shared alike by all interested in affairs electrical the nation over. It is to be hoped that some Western man may solve the happy slogan.

True Success in Engineering

To help another attain what we ourselves have missed does indeed spell for a life's work the magic word success. In the keen struggle of life many failing of a college technical education have fallen by the wayside under the keen edge of competition or survival of the fittest. Those, however, who have weathered the storm, like the giant sequoias in the rocky, wind-blown Sierra, stand forth indomitable in strength of character, capable of withstanding every human onslaught. That such men should be imbued with a burning desire to impart their hard-earned experiences to the young is indeed one of the most wholesome signs in the present day evolution of the engineering profession.

Many instances may be cited in Western engineering practice where real sacrifice of money and time and physical effort has been made on the part of the older brother in engineering to help the beginner. An incident of present sacrifice is that of a group of Western men engaged in a great utility who are giving of their money, their time and their physical effort, purely and unselfishly to help the beginner without any thought of recompense or reward. One of the lectures of these men appears as our leading article of this issue. Some issues back a lecture of another one of these men appeared in the columns of this journal. That successful men, though not college gradutes, thus contribute in university halls data of the utmost importance to our engineering profession is indeed an indication of the present day close linking of the university and the technical business world.

But to those men themselves, who give unselfishly of the best within them, the engineering profession owes much and the young, ruminating upon life and its real worth, may thus see emblazoned in livid words true success in engineering.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

T. H. Bibber, of Edwards & Company of New York City, is at San Francisco.

H. D. Betts, vice-president of Thomas & Betts Company, of New York, is at Seattle.

W. M. Doming, of the General Electric Company, has returned to the East from California.

H. B. Vanzwoll of the Sunbeam Incandescent Lamp Company will be in Seattle about the 15th of April.

W. d'A. Ryan, illuminating engineer of the General Electric Company, is at San Francisco from Schenectady.

E. M. Cutting, Pacific Coast manager for the Electric Storage Battery Company, is visiting the Pacific Northwest.

A. J. Myers, Pacific Coast manager for the Wagner Electric Manufacturing Company, has returned to his San Francisco office from Nevada.

C. Runnell, manager of the light and power department of the British Columbia Electric Railway Company of Vancouver, is at San Francisco.

A. L. Thorn has been succeeded as superintendent of light and power for the Tacoma municipal plant by **B. W. Collins**, Mr. Thorn occupying the newly-created position of commercial manager.

F. G. Baum, chief engineer of the Pacific Gas & Electric Company, spent the past week at the new Lake Spaulding development, where work will be now vigorously prosecuted when the weather moderates.

A. P. Davis, chief engineer, United States Reclamation Service, has returned to Washington, after completing an extended tour of the West in an inspection of several of the Government irrigation projects.

Robert Herzog, chief hydraulic and electrical engineer of the Great Northern Railway, is at Riverside, Washington, in charge of construction on the Chelan River power plant, which is being built by the Great Northern.

B. W. Collins, superintendent of electric works; **A. L. Thorn**, commercial agent; **John Bird** of the Kendrick Electric Company, and **David T. Dickson**, of Evans-Dickson Company, have been selected by the city council of Tacoma to establish power rates for the city.

C. L. Cory, professor of electrical engineering at the University of California, Berkeley, Cal., and **A. J. Thaler**, professor of electrical engineering at Montana State College, Bozeman, Mont., have been transferred to the grade of Fellow in the American Institute of Electrical Engineers.

W. L. Goodwin, vice-president and general manager of the Pacific States Electric Company has returned from a trip to the Portland and Seattle houses and announces the Seattle establishment has now fully recovered from the effects of the recent fire and will be in readiness for active business operations April 1.

Frank G. Drum was elected president; **John A. Britton**, vice-president and general manager; **A. F. Hockenbeamer**, second vice-president, treasurer and comptroller; **D. H. Foote**, secretary and assistant treasurer; **J. C. Love**, assistant treasurer; **Charles L. Barrett**, assistant secretary of the Pacific Gas and Electric Company at the annual meeting on April 8.

H. A. Lardner, Pacific Coast manager for J. G. White & Company, has returned to his San Francisco office after conferring with officials of the San Joaquin Light & Power Company regarding their new developments. **F. W. Gay**, mechanical engineer with the company, has completed an investigation of conditions for the turbo-generator plant at Bakersfield, of which **Robt. Brisbane** will have direct charge. **C. J. Rodin**, hydraulic engineer for the company, is at the site of the new development on the Tule River.

C. P. Guertler, formerly engineer in charge of construction of the Redondo plant of the Pacific Light and Power Corporation, is now in charge of construction of the Marconi Wireless Telegraph Company's big new towers at Honolulu, which are to communicate with similar towers on the California coast at Bolinas and Tomales, where **K. C. Weeden** has charge of construction, all this work being performed by J. G. White & Co.

Geo. Hewins, formerly superintendent of construction at the Crane Valley dam and recently in charge of J. G. White's construction at Mt. Hood for the Portland Railway, Light & Power Company, has left for a two weeks' trip east, after which he will return to California to become general superintendent of construction for the new developments of the San Joaquin Light & Power Company, which are being carried on by J. G. White & Company.

J. D. Ross, superintendent of the Seattle lighting department, announces that a 10,000 kw. steam plant is to be installed by the department. There will be 8-625 h.p. boilers feeding 2-500 kw. turbine sets. Steam heat will be used in the Denny-Furhman and Capitol Hill districts. These are two of the finest residence and apartment house districts in the city. The plant is to be situated on the east shore of Lake Union, accessible by either water or rail.

P. S. Biegler, professor of electrical engineering at the University of Montana, Missoula, Mont.; **L. B. Cramer**, electrical engineer Oregon Electric Railway Company, Portland, Ore.; **John B. Fisken**, superintendent light and power system Washington Water Power Company, Spokane, Wash., and **Edgar A. Wilcox**, commercial agent Great Shoshone and Idaho Consolidated Power Company, Twin Falls, Idaho, have been transferred to the grade of member in the American Institute of Electrical Engineers.

C. P. Backstrand, assistant at Riverside Electric Light Plant, Riverside, Cal.; **J. P. Cahan**, assistant civil engineer Western Canada Power Company, Vaucouver, B. C.; **M. L. Cox**, electrical construction for Pacific Gas and Electric Company, San Mateo, Cal.; **E. A. Crellin**, inspector of overhead construction Portland, Eugene and Eastern Railway Company, Portland, Ore.; **T. M. Snell**, electrical distribution engineer Pacific Gas and Electric Company at San Mateo, Cal.; **G. F. Springer**, electrical engineer Puget Sound Traction, Light and Power Company, Bellingham, Wash., and **A. C. Whitmore**, switchboard operator Madison River Power Company, Norris, Mont., have been elected associates of the American Institute of Electrical Engineers.

MEETING NOTICES.

Portland Jovian Luncheon Club.

Captain T. B. Steele, formerly attorney for Thomas A. Edison, gave a most interesting talk on Mr. Edison's life and work at the regular lunch of the Portland Jovians. F. D. Weber presided.

Oregon Society of Engineers.

The regular meeting of the Oregon Society of Engineers was held at their club rooms, 247½ Stark street, on April 10, 1913. Mr. Marshall Dana, associate editor of "The Oregon Journal," delivered an address on "The Press and the Professions."

Seattle Jovian League.

The John A. Roebling Sons Company, Seattle, furnished the entertainment at the Seattle Jovian League luncheon April 4. A splendid quartette rendered several appropriate selections, and the meeting was addressed by Mr. Foster, president of the Seattle Carnival Association. He spoke on the forthcoming Potlatch, and urged that the Jovians put

forth every effort to make the festival a success. The chief feature of the carnival this year will be the electrical pageant, and the Jovians intend living up to the opportunity which the occasion will offer.

The Southwestern Electrical & Gas Association.

The ninth annual convention of the Southwestern Electrical & Gas Association will be held at Galveston, Texas, May 21, 22, 23 and 24. In addition it has been found necessary to have "parallel sessions" for the gas members and accountants, these to "parallel" regular sessions which are on subjects not interesting to those attending the gas and accounting sessions. One full session will be given to the "Supply Men," who have promised that it shall not be the least interesting session of the convention. This will be followed in the evening, with a Jovian "Rejuvenation," at which the National Deities will preside.

Electrical League of Southern California.

The Electrical League of Southern California, which meets each Tuesday at the Angelus Hotel, has arranged the following program for April, 1913:

April 8th—Dr. Norman Bridge, "The Mexican Situation."

April 15th—Southern California Edison Day.

April 22d—O. H. Ensign, Chief Electrical Engineer U. S. Reclamation Service, "Power Development and the Reclamation Service."

April 29th—Woodill & Hulse Electric Company Day.

On Tuesday evening at 7:30 o'clock the Westinghouse Company invited the Electric League to a pool tournament to be held at their old location at 524 South Spring street.

Oregon Technical Club.

E. A. West was chairman at a meeting of 100 members on April 1st, when an "April Fool's Day" program was presented. The following program has been arranged for the month: April 8th—Jos. Jacoberger, chairman. Speaker, R. L. Sabin, of the School Board. Subject, "Schools as Social Centers." April 15th—Ellis F. Lawrence, chairman. Speaker, A. L. Peck, of the Oregon Agricultural College. April 22nd—J. E. Davidson, chairman. Speaker, Guy W. Talbot, president Pacific Power and Light Company. April 29th—C. F. Blake, chairman. Speaker, Dr. Elliott of Reed College. After the 1st of May the luncheon day will be changed to Monday. The luncheons will continue to be held at the Portland Commercial Club.

San Francisco Electrical Development and Jovian League.

The regular monthly business meeting was held Tuesday last. Reports of the various standing committees were read and adopted.

The San Francisco Committee on Electrical Matters reported favorably on the proposed ordinance regulating electrical installations within the city and licensing master electricians. The ordinance is to come before the board of supervisors within a day or two for consideration. Notice was given of proposal to amend the constitution and by-laws of the League so as to provide for a legislative committee in addition to the other standing committees and extending the term of office for which the president and vice-president shall serve from six months to one year.

NEWS OF WASHINGTON PUBLIC SERVICE COMMISSION.

The commission has entered an order fixing the value of the properties of the Whatcom Railway & Light Company at Bellingham at $2,150,000. The values have been classified as follows: Railway system, $1,100,000; power and light system, $750,000; gas system, $300,000.

Application has been made by the Puget Sound Traction, Light & Power Company to put into effect without the usual statutory 30 day notice a rate of 1¾ cents per kilowatt hour for "mercantile business having at least 250 kilowatts of day load throughout the year, guaranteeing $10,000 per minimum, bills based upon a ten year contract." The commission is investigating the matter but will probably render its decision very shortly.

The Pacific Power & Light Company, North Yakima, Washington, has announced a cut in gas to consumers using less than 5000 ft. from $1.75 to $1.60 a thousand ft. For consumers using more than 5000 cu. ft. of gas the rate is $1.35 per thousand up to 10,000 with 10 per cent off and the rate is 85 cents a thousand with ten per cent reduction for any amount in excess of 10,000 ft.

The city council of Puyallup, Washington, is seeking a lower rate on electric lighting. The contention is made that a rate of 10 cents a kilowatt with a minimum charge of $1.00 a month is too high. It has been decided to refer the matter to the public service commission for decision.

TRADE NOTES.

The Olympic Portland Cement Company of Bellingham, Washington, recently placed an order through the Westinghouse Electric & Manufacturing Company at Seattle for a three-phase, 220 volt, 6 ton mine type locomotive. Same is equipped with two 15 h.p. motors and two trolleys with track return.

The Globe Electric Company, dealers in wholesale electrical supplies now located at 406 Fourth avenue, will move about the middle of the month to 902 Western avenue in order to have larger and more convenient quarters.

NePage, McKenney & Company, electrical contractors, Seattle, report that their firm has the contract for wiring the Christian Science church recently constructed in Seattle, the Central school building in Tacoma, the 15-story Weart building in Vancouver, B. C., and for alterations on the Arcade building at Seattle. The jobs approximate $3000, $8000, $18,000 and $5000 respectively.

EXAMINATION FOR DEPUTY INSPECTOR OF ELECTRICITY.

On April 17, 1913, there will be held at the City Hall, Portland, Oregon, an examination for Deputy Inspector of Electricity; salary, $100 per month.

Any man 21 years of age and a citizen of the United States is eligible to take this examination if he is also a practical electrician, qualified to pass upon the safety and efficiency of wiring and appliances. The examination will be graded and marked on the following basis:

Electricity: Theory and practice of the use of electricity in buildings for light and power will count 10 points.

Electrical Wiring and Apparatus: The requirements of the ordinances for the installation of electrical wiring and apparatus will count 40 points.

Practical Questions: Details of wiring and the installation of electrical apparatus will count 50 points.

BOOK REVIEWS.

Gas Power. By C. F. Hirshfeld, M. M. E., and T. C. Ulbricht, M. M. E. Size, 5½ x 7½ in.; 209 pages; 60 illustrations; cloth binding. Published by John Wiley & Sons of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $1.25.

The authors, who are respectively professor and instructor at Sibley College, Cornell University, have endeavored to give the reader such knowledge of the methods and facts of gas power as may enable him to appreciate the present commercial status of this branch of engineering. The treatment is simple and non-mathematical and is hence an excellent book for manual training schools and other institutions devoted to industrial education. For electrical men who desire to obtain a first knowledge of gas power principles the book, too, should prove of great value. The internal combustion engine now threatening to enter the coast field of activity may thus be seen in its elements.

INDUSTRIAL

A SOCKET THAT LOCKS.

"Shurlock," the socket that locks, is a simple device recently put on the market by Pass & Seymour to prevent the unauthorized removal of lamps or reflectors from fixtures. This not only protects from theft but also from the use of

A New Lamp Protector.

heating appliances on hotel circuits, and furthermore holds the lamp so that it cannot jar out.

The lamp is held in place by a recessed screw which can be removed only by a special key sold only to responsible parties.

WESTERN ELECTRIC 1913 FANS.

The pressed steel fans, brought out last year by the Western Electric Company, met with such marked approval and covered the field so thoroughly that it was not found necessary to make any changes in design for the 1913 season.

A few additional types have been made, however, chief among which are the 8-inch induction type and the 16-inch residence type fans. The 8-inch induction type was added to meet a demand for this type of fan. It is made for 50 and 60 cycle frequencies from 100-110, 111-120 and 200-230 volts, and is furnished in the regular standard finishes to which has been added a new white nickel finish in which the 8-inch series fans are also furnished. White nickel is especially adaptable for doctors' and dentists' offices, barber shops, hospitals and for use in connection with bathroom fixtures.

A complete new line of 16-inch residence fans has been added for operation on standard voltages and from 25-30, 40 and 50 cycle frequencies. The 12-inch residence line of fans has been extended to include 25-30, 40 and 50 cycle frequencies and standard voltages.

The 32-inch ceiling fans have also been extended to include 25-30, 40 and 50 cycle frequencies, thus placing the Western Electric Company in a position to offer a full line of small size alternating current ceiling fans. One standard finish—black enamel—has been adopted for all desk and bracket type fans.

NEW CATALOGUES.

Bulletin No. A4092 has just been issued by the General Electric Company, describing its Type I-10 Thomson Watthour Meter.

Bulletin No. 8 from the Weston Electrical Instrument Company is devoted to Miniature Precision Direct Current Instruments for both switchboard and portable use.

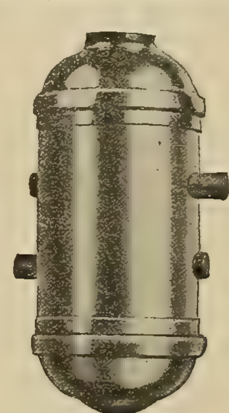
The Engineering Department of the National Electric Lamp Association has issued Bulletin 11A on Mazda Street Series Lamps, giving data on their properties and characteristics.

Under date of March, 1913, the Cutler-Hammer Manufacturing Company of Milwaukee has issued Bulletin 8650, which illustrates and lists all of the C-H push button switches, attachment plugs, receptacles, cord connectors, sockets and plates. This Bulletin 8650 supercedes one of the same number published in January, 1912. A number of new devices are listed and the size of the Bulletin increased.

Bulletin No. 61, "Characteristics and Limitations of the Series Transformer," by H. R. Woodrow and A. R. Anderson, has just been issued by the Engineering Experiment Station of the University of Illinois. This bulletin presents the results of a theoretical investigation of the characteristics and limitations of the series transformers more particularly in connection with its use in recording transient currents. Copies of Bulletin No. 61 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

NEW CUTLER-HAMMER TWO-CIRCUIT SWITCH.

For controlling two groups of lamps in a large cluster or chandelier two-circuit pendent switches are used extensively. Also for fan electroliers where the fan and the lamps may be used at different times, the two-circuit pendent affords convenient control. The lamps or the fan may be operated independently, which is often desirable, as the fan may be needed during the day, when the lighting of the lamps would not be necessary. The Cutler-Hammer Manufacturing Company of Milwaukee has added to its porcelain type a brass shell two-circuit pendent, as shown in the illustration.



Cutler-Hammer Two-Circuit Switch.

The small, quick-break twin mechanisms used in this switch are mounted in a single composition base. Each mechanism is operated by its own push bar, which has a light button at one end and a dark one at the other. The pushing of the light one closes the circuit, while pressure on the dark button opens the circuit.

The switch is of neat design and the mechanism so arranged as to make the operation most convenient. Grasping the switch places the thumb in position to easily operate the push bars. The rating is 6 amperes, 125 volts; 3 amperes, 250 volts, and the approval of the Underwriters' Laboratories has been obtained for this switch, each one bearing the Underwriters' label.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

RECOMMENDATIONS FOR ELECTRICAL INSTALLATIONS IN WOOD WORKING PLANTS, MANUFACTURING PLANTS, WAREHOUSES, PACKING HOUSES, CANNERIES, MINING PLANTS, ETC.

COMPILED BY F. D. WEBER.[1]

(Continued)

14. Sockets. In damp or wet places weather-proof sockets must be used. They must be hung by separate stranded rubber-covered wires not smaller than No. 14 B. & S. gauge, which should preferably be twisted together when the pendant is over three feet long. These wires must be soldered direct to the circuit wires but supported independently of them by knobs. (Rule 31b.)

In dry places stranded brewery cord or packing house portable cord and keyless brass sockets may be used.

The lamp globe in all cases must be protected by an approved wire guard.

In rooms where inflammable gases may exist the incandescent lamp and socket must be enclosed in a vapor-tight globe. (Rule 31a.)

Rosettes should never be used.

Key sockets must not be used. (Rule 31c.)

15. Control Switches for Drop Lights. Drop lights should be controlled by switches, placed in the branch cabinets, or wall switches conveniently located. Snap switches must not be used unless enclosed in dust or moisture-proof cabinets. Knife switches, if exposed to dust, must be placed in cabinets, and if exposed to moisture must be placed in a moisture-proof cabinet or be mounted on porcelain knobs. (Rule 19c.)

16. Portable Lamps. Where long drop cords or portable lamps are necessary the cord must be of the reinforced portable type (preferably what is known as packing house portable cord), and the lamp must be provided with a good substantial guard. (Rule 32d and 54, Section c, Division 2.) The best practice is to use a detachable portable extension made of the portable cord specified above,. with an attachment plug and a lamp provided with a good substantial guard with wooden handle and hook on tip.

When lights must be suspended over the work, in lumber mills, planing mills, etc., make an inverted trough of 1 in. lumber, painted white on inside, and support the wire on the inside of the trough. Wooden moulding will not be approved for use with this trough. The connection between the trough and the rest of the system should be made with a stranded rubber covered wire, properly dead-ended.

17. Arc Lamps. Each lamp must be protected by an approved double pole cutout and each arc should be preferably on a separate circuit. Must be supplied with globes and protected by spark arrester and have wire netting around the globe, the mesh not exceeding 1½ in. (Rule 33a to d.)

For Open Knob and Cleat Work.

18. Cabinets must be substantially constructed. If of wood use well seasoned lumber. The door must hinge from the top in order that it may be self-closing, close against a rabbet and be provided with a substantial catch. The bottom must have a slope of 45 degrees to prevent the accumulation of any foreign material. The cabinet must be well painted with moisture proof paint and then lined with asbestos board at least one-eighth inch thick, same to be securely tacked in place and the whole to be well painted. The door must be lined the same as the cabinet. (Rule 70.)

Iron cabinets only will be sanctioned with metal conduit, and are recommended for use with knob and tube work, as they are more durable and generally better constructed. (Rule 70.) These must also have doors hinged at top and have the door overlap sides and bottom of cabinet, making the hinged part of door also dust tight. The bottom must have a slope of 45 degrees to prevent the accumulation of any foreign material.

19. Insulating Supports and Bushings. Wires must be supported at least 4½ ft. by single wire cleats or knobs. (Never use two-wire cleats, as dust or mositure is liable to collect between the two parts and may cause a short circuit.) Wires passing through walls, timbers or floors should be kept from contact with woodwork by porcelain insulating tubes, which must be long enough to bush the entire length of the hole in one continuous piece. (Rule 16, Sections d and e.) Bushings through floors should extend at least one inch above the floor in order to prevent dust and sweepings from collecting in the tubes. The tubes should be protected from mechanical injury by a suitable protecting box of wood or approved metal conduit.

20. Protection to Wires. Where wires run on low ceilings, on walls or partitions or supporting posts, or close to belts, pulleys, etc., they must be protected from mechanical injury. (Rule 20e.) Adequate protection on low ceilings is secured by wooden guard strips placed on each side of and one inch from the wires. These strips should be at least one inch thick and two inches high. Wires must never be run from timber to timber. A good substantial running board, preferably a 2x6 in., must be put up and the wires knobbed to the under side, and then guard strips put up in addition if the wires are exposed to mechanical injury. And if wires are exposed to excessive moisture, guard strips and running boards should be put up forming an inverted trough to protect the wires from the same.

Suitable protection on walls, partitions and vertical timbers may be obtained by substantial boxing enclosing the wires, same to extend not less than seven feet from the floor. Boxing should be closed at the top to keep out dust, etc., the wires passing through bushed holes. Wires must have at least an inch separation from the inside of the boxing.

Instead of guard strips or boxing, wires may be run in approved metal conduit installed according to (Rules 27 and 28, N. E. C.)

Wires must be rubber-covered, unless run in open dry places, and then slow-burning wire may be used. (Rule 28, Sections g and i.)

For Conduit Work.

22. Cabinets must be constructed of steel or iron and be of approved make. (See Division 18 of this pamphlet.)

23. Conduit must be well supported with pipe straps. All elbows or bends must be made so that the enameling or coating will not be injured. Ends must be well reamed. Where entering cabinets or outlet boxes must be provided with a lock nut and bushing. The lock nut must be screwed up tight in order to make a good electrical connection as well as mechanical. Where wires leave the end of the conduit the conduit must always be provided with a condulet or outlet box, the wires passing out through separate holes bushed with porcelain. Drop cords may pass through a bushed hole in the top of the outlet box and then knotted on the inside. All lengths of conduit must be permanently and effectively grounded. The ground wire must make good electrical connection with the conduit. (Rules 27c and 28f.)

24. Wires used with metal conduit must be double braid rubber covered. (Rule 56.)

[1]Electrical Inspector for Underwriters' Equitable Rating Bureau, Portland, Ore.

Outside Wiring.

25. Aerial Construction must be so placed that moisture cannot form a cross-connection, between wires, and except when run in conduit, not less than a foot apart, and not in contact with any substance other than their insulating supports. Wooden blocks to which insulators are attached must be covered over their entire surface with at least two coats of waterproof paint.

For conduit work, wires must be placed so as to conform to rules for unlined conduit except that conduit system must be waterproof. (Rule 12a to h.)

26. Lighting Over Platforms. If the lighting is to be over platforms, tramways, etc., it is much better to run the wires underneath the same. Wires to be supported at least every 10 ft. by petticoat insulators of glass. Branch wires or taps from main wires up to lamp sockets should be run in continuous lengths of approved metal conduit, extending from the under side of the platform up a good substantial lamp post. The lower end of the conduit (under the platform) must be equipped with a condulet or an outlet box, the wires passing through separate insulated holes. The upper end must be bent downward, forming an inverted "U," in order that the moisture cannot enter the conduit, and the end equipped with a condulet, or the weatherproof socket must screw directly to the conduit.

Also, open wiring may be used if same is thoroughly protected from mechanical injury. (See Division 20 of this pamphlet.)

27. Branch Circuits. The lights may be controlled from cabinets underneath the platforms.

28. Wires must be rubber covered or weatherproof, except in the conduit mentioned in Section 26, where double braid rubber-covered wires must be used. (Rules 12a and 56.)

29. Sockets must be weatherproof.

30. Arc Lamps must meet the requirements for arcs mentioned in Section 33.

31. Cabinets must meet requirements specified in Section 70 of the National Electrical Code, and Divisions 18 and 22 of this pamphlet, and in addition must be waterproof.

Motors and Motor Wiring.

32. Motors when operating at a potential of 550 volts or less must be thoroughly insulated from the ground wherever feasible. (Rule 8a.) This can most always be accomplished by a good substantial wooden base frame. Enclose the motor in a dust-proof room when direct current motors or motors with sparking contacts, are used. Such enclosures should be readily accessible, dust proof and sufficiently ventilated to prevent an excessive rise of temperature. The sides should be made largely of glass so the motor may be always plainly visible.

For "high tension" motor installation see "Wiring Data

Oil Transformers.

6a. Must not be placed inside of any buildings except central stations and substations, unless by special permission of the inspection department having jurisdiction. (Rule 36a.)

When permitted inside buildings under Rule 14, N. E. C., must be located as near as possible to the point at which the primary wires enter building. (Rule 45a.)

Must be placed in an enclosure constructed of fire-resisting material; enclosures to be used only for this purpose, to be securely locked, and access only allowed to responsible parties. (Rule 45b.)

Must be thoroughly insulated from the ground or permanently and effectually grounded, and the enclosure in which they are placed must be practically air tight, except that it may be thoroughly ventilated to the outdoor air, if possible through a chimney or flue; there should be at least 6 in. air space on all sides of the transformer. (Rule 45c.)

In order to obtain the approval required of the inspection department, as stated above, transformers must be safeguarded by resting on concrete of at least three (3) in. in depth; be placed immediately under the sidewalk if possible, in an enclosure which must be ventilated by an opening at least six (6) in. square through the sidewalk or to chimney or flue; the fire-resisting material used in constructing the enclosure in which the transformer is located, and by which it is effectually cut off from the remaining part of the basement, must consist of a brick or concrete wall at least eight (8) in. in thickness and have no communication into rest of building unless access is obtained through an approved fire door. The transformer room so constructed must be supplied with sill, to prevent the flow of oil into the basement in case of explosion.

As an alternative to the above construction, the transformer may be placed in a tight steel tank, ventilated to the street and standing on concrete.

(To be continued.)

CALIFORNIA ELECTRICAL CONTRACTORS' CONVENTION

The fourth annual convention of the California State Electrical Contractors' Association, will be held at Santa Barbara, August 13, 14, 15 and 16, 1913, headquarters being established at the Hotel Potter. Arrangements are already under way which assure the success of this meeting and a large and esthusiastic attendance is anticipated. In addition to an excellent program of papers, to be announced later, an elaborate entertainment is planned and a great Jovian Rejuvenation will be conducted under the auspices of the various California Statesmen. The following committees have been appointed, the first-named being chairman in each case:

Committee of Arrangements.

J. C. Rendler — J. S. Reynolds — F. Neilson
C. Loveday — W. S. Hanbridge

Finance Committee.

C. Loveday — G. Arbogast — W. S. Hanbridge

Reception Committee.

J. S. Reynolds — F. Neilson — R. Smith
C. Loveday

Ladies Reception Committee.

Mrs. J. S. Reynolds — Mrs. F. Neilson — Mrs. C. Loveday
Mrs. R. Smith

Boosters' Committee.

Mr. and Mrs. C. V. Schneider, Sacramento.
Mr. and Mrs. L. Youdel, Stockton.
Mr. and Mrs. F. Somers, San Jose.
Mr. and Mrs. W. Thomas, Petaluma.
Mr. and Mrs. C. F. Butte, San Francisco.
Mr. and Mrs. E. C. Wakeland, Oakland.
Mr. and Mrs. H. Lewis, Fresno.
Mr. and Mrs. J. Endert, Bakersfield.
Mr. and Mrs. M. Phillips, Ventura.
Mr. and Mrs. G. Arbogast, Los Angeles.
Mr. and Mrs. H. Miller, Pasadena.
Mr. and Mrs. C. Heilbron, San Diego.
Mr. and Mrs. H. Ross, Riverside.
Mr. and Mrs. E. F. Burkhart, Palo Alto.
Mr. and Mrs. E. Granger, Pomona.

Entertainment of Ladies and Visitors.

Arthur Rowe. He to select his own assistants.

Banquet Committee.

C. Loveday — W. A. McNally — R. Farrell

Picnic Committee and Sports.

R. Smith — F. Neilson — G. Arbogast
L. Gans

Prize Committee.

L. Levy — J. S. Reynolds — J. C. Rendler

Music and Printing Committee.

F. Neilson — J. S. Reynolds — C. Loveday

Transportation Committee.

W. S. Hanbridge — J. S. Reynolds — J. C. Rendler

Rejuvenation, Sons of Jove, Committee.

A. H. Halloran — T. E. Bibbins — S. E. Sanderson
R. B. Clapp — M. Steel — A. Rowe
C. V. Schneider

Convention Papers Committee.

H. Miller — C. F. Butte — F. Neilson

NEWS NOTES

INCORPORATIONS.

TACOMA, WASH.—The Tacoma Electrical Machinery Company has recently been incorporated with a capitalization of $20,000 with J. C. Hill as president; J. W. Holmes, secretary, and W. D. Ludwick, treasurer, and with offices and shop at 759 South D street.

GRANTS PASS, ORE.—The Rogue River Public Service Corporation, a company composed of the creditors of the Chicago-Rogue River Company, bankrupt, has been organized to take over the latter named company and also the Oregon Water & Power Company and the Golden Drift Mining Company. It is the purpose of the new company to consolidate the properties of the above-named companies and to pay creditors 20 per cent of their claim in cash and give first mortgage bonds of the new corporation for the balance. The object is to go ahead with the irrigation and power business on a large scale and to build two more power plants and construct about 50 miles of irrigation ditches and for that purpose the company has authorized a bond issue of $1,000,000 of which issue they expect to sell $600,000 par value for development purposes and use $400,000 to pay off old bonds, claimants, and clear the property except for the bond issue. The officers are George E. Sanders, president; F. A. Fauvre, vice-president; Ovanda C. Beebe, treasurer; George W. Soranson, secretary, and Robert E. Gaut, consulting engineer.

ILLUMINATION.

SODA SPRINGS, IDAHO.—The Utah Power & Light Company has applied for a franchise here.

EPHRATA, WASH.—This city will have a municipal lighting system installed this spring at a cost of $10,000.

UNION, ORE.—Green Bros., Spokane, have offered to install a city lighting plant and accept city bonds in payment.

WHITE SALMON, WASH.—It is rumored that the Northwestern Electric Company will build a plant on the power site recently purchased on White Salmon River above Husum falls.

NELSON, B. C.—David Walmsley, director of the Waneta Development Company, states that $75,000 will be expended on the power plant at the junction of Salmon River and Pend Oreille River.

UNION, ORE.—The city council has taken up the proposition of Green Bros. of Spokane, to install a municipal lighting plant for the city at a cost of $72,000, according to plans and specifications of F. S. Kelsey of Portland.

VENICE, CAL.—The board of trustees has awarded the contract for the installation of a street lighting system, consisting of concrete lamp posts, and galvanized pipe conduits, to the Coast Electric & Machinery Company, for $14,940.

SAN BERNARDINO, CAL.—C. M. Grow, manager of the Southern California Gas Company, has announced that work will be commenced on April 5th on the laying of the high pressure gas main from the company's central plant at Colton to Loma Linda to give that community gas service.

OAKLAND, CAL.—Application was made to the city council for a franchise by the Great Western Power Company for permission to erect, construct and operate wires, poles, and lay conduits for the purpose of transmitting electricity to certain parts of the city of Oakland. Sealed bids will be received up to May 2 for the sale of said franchise to the highest bidder.

TACOMA, WASH.—The St. Paul & Tacoma Lumber Company will install a steam turbine generator current to operate the entire plant. A capacity of 1350 horsepower will be had. Waste wood that otherwise would be burned in the refuse burner will be used to develop the power. The company will also build an addition to its machine shops at a cost of $1000. A considerable amount of new repair tools will be bought.

ESCONDIDO, CAL.—That the Escondido Light & Power Company should present more data regarding its plans for installation of lighting and power plant was the ruling of State Railroad Commissioner Max Thelan, after hearing its application for permission to sell $49,500 shares of its capital stock for the purpose of realizing money for putting in the plant. The hearing was adjourned to some later date, to be announced by the commissioner.

LOS ANGELES, CAL.—Plans for lighting of Long Beach boulevard from Huntington Park to the ocean front, a distance of approximately 15 miles, as proposed at a banquet held not long ago in Cudahy city, is in the hands of a committee which has actively undertaken the project. It is understood that ample funds will be forthcoming to finance the enterprise. Victor G. Kleinberger has been appointed chairman of the committee on plans, and others named are: R. L. Bisby, secretary of the Long Beach Chamber of Commerce; S. M. Burbank and J. H. Keifer of Bells.

SAN FRANCISCO, CAL.—City Attorney Long has addressed Chief Nixon of the Department of Electricity that lighting companies have the right to make service connections of their systems where such are asked for, provided such extensions do not have to be more than 100 ft. long, and that no effort shall subsequently be made to make another connection with the first extension with the idea of so carrying the system on indefinitely, 100 ft. at a time. This right only applies, the attorney explains, to extensions to be made from main service lines in use prior to the going into effect of the constitutional amendment of October, 1911, providing new regulations for the use of street roadways by public service corporations, and requiring them to obtain permission from the local governing bodies before disturbing streets.

BAKERSFIELD, CAL.—Attorney Frank Short of Fresno, who is representing the Bakersfield Gas & Electric Company in the suit filed by that company to have the ordinance fixing a maximum of 50c per 1000 for gas set aside, has signed a stipulation with City Attorney Laird to the effect that a temporary injunction may be issued preventing the ordinance from going into effect, and that all moneys collected by the gas company in excess of the rate fixed by the ordinance shall be impounded in the First National Bank until the case is decided. The stipulation also gives the city until May 1 to answer the complaint in equity which the gas company has filed in the Federal Circuit Court at Los Angeles. The injunction will be issued by Federal Judge Olin Welborn. Meantime the gas company will give receipts to gas consumers showing the amounts they have paid in excess of the rate fixed by the city and these receipts will be good for the difference in case the courts eventually uphold the ordinance. Meantime also, the city will gather such data as may be needed to support the claim that the ordinance is not confiscatory, as the gas company claims.

TRANSMISSION.

JUNEAU, ALASKA.—The Gastineua Mining Company will build by force account a dam on Salmon River this year to develop 3000 h.p.

TOLEDO, ORE.—The Independent Electric Company, a subsidiary of the Washington-Oregon corporation, has applied to the commissioners for a power line between here and Winlock.

BURNABY, B. C.—Superintendent Wm. McNeill of the Western Canada Power Company, states that the power line across Burnaby to the north arm of the Fraser River and Lulu island is contemplated.

IDAHO FALLS, IDAHO.—The Utah Light & Power Company have asked for a franchise and annulment of connection with the Idaho Power & Traction Company, whose business they have recently purchased.

CALDWELL, IDAHO.—The Idaho-Oregon Light & Power Company are securing right of way for the construction of a power line from the Swan Falls plant on Snake River to the pumping plant of the Gem Irrigation District.

MONTESANO, WASH.—W. L. Hawkes, manager, states that the headworks of the plant of the Northwest Electric & Water Works will be relocated and completed at the head of Sylvia Creek. The water mains and light wires will be extended.

BELLINGHAM, WASH.—Henry W. Grant has filed with the county auditor a claim to the use of some 25,000 cu. ft. per second of the waters of Baker River. According to the claims that have been filed it is the plan to construct a dam in the stream at each of the sites filed upon and to build a short distance from the dam a power plant which will develop power for distribution to various other localities.

LOS ANGELES, CAL.—Officers of the Dixie Queen Mining Company have filed notice with the board of public works that land to be used in the construction of the San Francisquito canyon power plant No. 1 of the aqueduct power plant system, has been filed on for more than ten years by that company for mining claims, and that the company will fight all efforts to use the same for power plant purposes.

PORT ANGELES, CAL.—The Olympic Power Company at Port Angeles, Washington, has laid about 9000 ft. of submarine cable across Hoods canal from Port Ludlow to Port Gamble. A 1500 3-phase, 13,200 volt cable furnished by the United States Steele Products Company of Seattle was installed. The cable is peculiar in that it has not a lead cover and was furnished in one continuous piece. It is immersed at one point to a depth of 350 ft. Transformer substations have been provided at the shore ends, stepping down from 66,000 to 13,200 volts at the north bank, raising again to 66,000 volts at the south bank and continuing on to Bremerton.

PORTLAND, ORE.—At the Northwestern Electric Company's White Salmon power house, 75 miles from Portland, the water was turned into the reservoir and one of the units of the great hydroelectric plant was given its first test. The machinery ran very smoothly. The company has the largest wood stave pipe line in the world, the inside measurement being 13 ft, 6 in. Poles have been raised from the plant to Camas, 22 miles from Portland, and the wires are now being strung. The company will soon be ready to supply power to the Crown-Columbia paper mills at Camas. It is expected that construction work will be sufficiently advanced by September 1 to enable the company to distribute power in Portland.

San Francisco, Cal.—The leading feature of the annual meeting of the Pacific Gas and Electric Company on April 8 was the annual reports presented by General Manager Britton and Treasurer Hockenbeamer upon the activities of the company for the year ending December 31. Under the head of statistics the report shows nine hydroelectric power plants in operation, with with a total installation of 90,227 h. p. To this may be added four steam electric plants in operation in the four big cities of the company's territory—San Francisco, Oakland, San Jose and Sacramento—with a total generating capacity of 94,100 h. p. The number of consumers of electricity is given as 116,666. The statistics from the gas department show the number of gas plants in operation by the company as 17, including plants in the principal cities of the territory covered by the company's system. The number of gas consumers in 1912 was 196,133, and the total amount of gas sold, 6,691,072,400 cubic feet. From the water department the figures show 8071 water consumers during the year. The company's system includes a reservoir capacity of 2,472,509,500 cubic feet. The company operates the electric street railway in Sacramento, which has a total mileage of 40 miles, operates 62 cars, and in the last year carried 11,926,098 passengers. In addition, the company supplies 11 other electric railway systems with power for operating purposes, with a total mileage of 594. In the report presented by Second Vice-President and Treasurer Hockenbeamer he showed that in the seven years since the organization of the company it had expended $31,415,232 for plant additions. During the same period the total par value of its outstanding bonds has increased $23,200,000, indicating the creation of an equity for the bondholders of the company in excess of $8,000,000. During 1912 $1,014,000 of the bonds were retired through the operation of sinking funds, making the total so retired to December 31, 1912, $6,167,000. Since 1907 the company's annual taxes have increased from $247,000 to $622,000.

TRANSPORTATION.

VALLEJO, CAL.—The Northern Electric Railroad Company is preparing to erect large warehouses here.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will proceed immediately to electrify the Mount Hood steam line from Gresham to the Mount Hood plant on the Bull Run River, a distance of 22½ miles. This work was decided on after a tour of inspection, this week, by the officials of the company.

SAN FRANCISCO, CAL.—The board of public works has authorized Secretary Churchill to advertise for proposals, to be opened April 16, for building the extension of the Municipal Railway from Thirty-third avenue and Geary street to the ocean, via Thirty-third avenue, Balboa street, Forty-fifth avenue, Cabrillo street and the Great Highway.

MARTINEZ, CAL.—The Oakland & Antioch Railway, through its subsidiary corporation, the San Ramon Valley road, has awarded the contract for the building of the electric line from Walnut Creek to Danville, seven miles, to Palmer, McBride & Quayle. Work will start at once and will be rushed in order that the line may be in operation by July 1.

LONG BEACH, CAL.—A permit has been granted by the board of public works to the Pacific Electric Company to begin repairs on its tracks on Pine avenue, and a large force of men will be put to work at once. Besides Pine avenue, from Sixth street to Ocean avenue, Pacific avenue, and First street, will also be repaired. The cost of the proposed repairing will cost about $70,000.

SAN FRANCISCO, CAL.—There will be a system of 12 tracks in the Transportation building at the Exposition with strength to carry locomotives with axle loads of 60,000 lbs. There will also be tracks to carry lighter exhibits, such as railway coaches and other equipment. Over half of the area of the building will be devoted to equipment of tracks, the remainder of the building being given to railway devices and safety equipment.

SAN FRANCISCO, CAL.—General Manager Black of the United Railroads told the public utilities committee of the supervisors that his company could not undertake to build any extension of its lines under the existing charter conditions. This statement was in response to a request that the United Railroads extend its Brannan street track along First street to the Mail dock, a distance estimated at about 550 ft. Manager Black said this extension would cost from $7000 to $10,000 and would be a source of expense for maintenance without bringing in any additional revenue, while every dollar that the company could spare was needed for the reconstruction of tracks and pavements which had been ordered by the supervisors.

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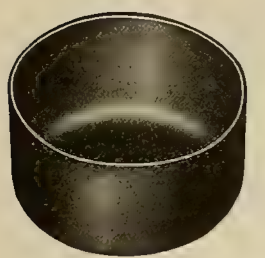
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Tubes and Bushings
Ohio Brass Company
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee," Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758 W. Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas & Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 Pacific Blg.
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco, 682-684 Mission
Wilson Machinery Co.
San Francisco, 861 Market

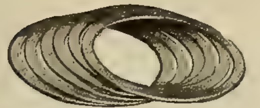
This Trade Mark The Guarantee of Excellence on Goods Electrical.

Punched Disc.



Cupped and Trimmed.

Blank Punched Out of Bottom.



Spacing Rings.

Assembled Field Punchings for A. C. Motors.

Drawn Shell Construction for Small Alternating and Direct Current Motors

The illustrations show the principal steps in the construction of the "Drawn Shell" motor manufactured by the General Electric Company.

To all who possess a quick discernment for real values in goods electrical, "Drawn Shell" construction has many interesting features which become readily apparent from a close inspection of the product.

Uniformity of excellence in the material used for Drawn Shell motors is obtained through purchase in large quantities under rigid specifications. As the combined result of unequalled tool equipment, scientific manufacturing processes, the employment of expert workmen, and final testing under the supervision of the Designing Engineers, a practically flawless finished product is assured.

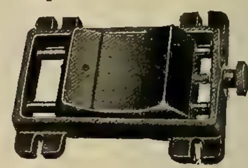
The satisfactory continuous operation at brake horsepower rating of all Drawn Shell Motors, with ample margin for reasonable overloads without sparking or overheating, is made certain by a careful, initial design and those niceties in mechanical and electrical construction, characteristic of all material bearing the trade mark "G-E".

Drawn Shell Motors are used to drive small machine tools, pumps, compressors, vacuum cleaners, sewing and washing machines, etc., etc.—these sturdy little motors meet an infinity of power purposes for shop, factory, store, office or home.

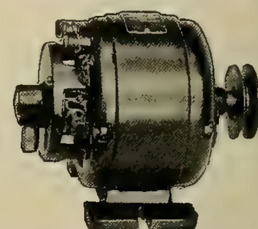
Sizes 1/50 to 3/4 H.P.—with open or totally enclosed frames.

Bulletin No. 4963 giving a complete description of Drawn Shell Motors will be gladly sent on request to the nearest office of the General Electric Company.

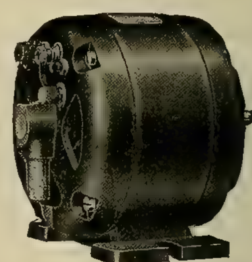
Rings and Punching Clamped by Forcing Over Edges of Cup.



Sliding or Plain Removable Base Furnished as Desired.



Type DSD Direct Current Motor



Type DSS Single-Phase Alternating-Current Motor.

Type DST Three-Phase Alternating-Current Motor.

General Electric Company

Largest Electrical Manufacturer in the World

General Office: Schenectady, N. Y.

Pacific Coast Sales Offices in San Francisco, Los Angeles, Portland, Seattle and Spokane
Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho

4092

The Trade Mark of the Largest Electrical Manufacturer in The World.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX | SAN FRANCISCO, APRIL 19, 1913 | NUMBER 16

New Vertical Lift Bridge at Tacoma, Wash., Showing Span Raised, Thus Giving a Clearance of 135 ft. Above High Tide.

ELECTRO-MECHANICAL EQUIPMENT OF A LIFT BRIDGE

There has recently been put in commission at Tacoma, Washington, a new vertical lift bridge crossing the city waterway and leading from the business section to the manufacturing section located on the tide flats.

This bridge presents several interesting features to the engineering fraternity, among them being the lift itself which is the first one ever built on a grade, and the overhead pipe truss carrying water mains, gas mains, etc. From the electrical engineer's point of view it is of interest as being the first bridge of this type having all operations controlled from one point. Its successful operation also clearly demonstrates that electricity is the ideal motive power for operation of bridges of this character, as it permits the installation of many safety devices and gives the requisite range of power.

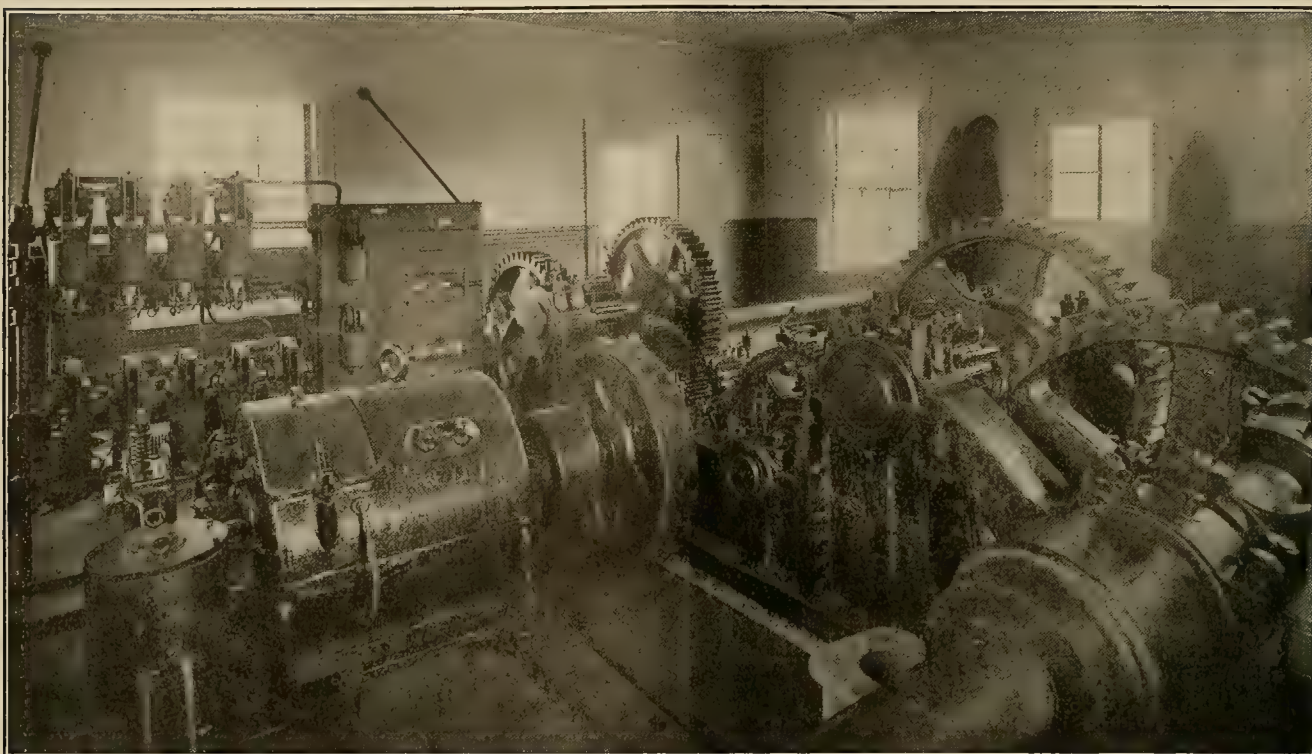
The movable part of the bridge is a steel span 212 ft. in length weighing 840 tons. It is counterbalanced by two concrete counterweights weighing 420 tons each. Motive power for raising and lowering the span is required to overcome the friction of sheeves, cables, drums and gearing. This requires 200 horsepower at starting and 75 horsepower during the balance of the operation of moving the span the 75 ft. which it travels. The time required is 40 seconds. The 200 horsepower load endures about 10 seconds of this time. Motive power is furnished by 2-500 volt d.c. 75 horsepower Westinghouse series wound street railway type motors so connected as to run in series or multiple as desired. They are controlled by a master controller and relays similar to interurban car equipment. Motors are equipped with solenoid brakes which are automatically set when the bridge is at rest. A hand brake is also provided to be operated from the operator's cage.

Current for these motors is conveyed to the switchboard by means of vertical trolleys placed on the towers of the bridge, and is collected by trolley wheels secured to the span, both ends of the bridge being so equipped as an emergency precaution.

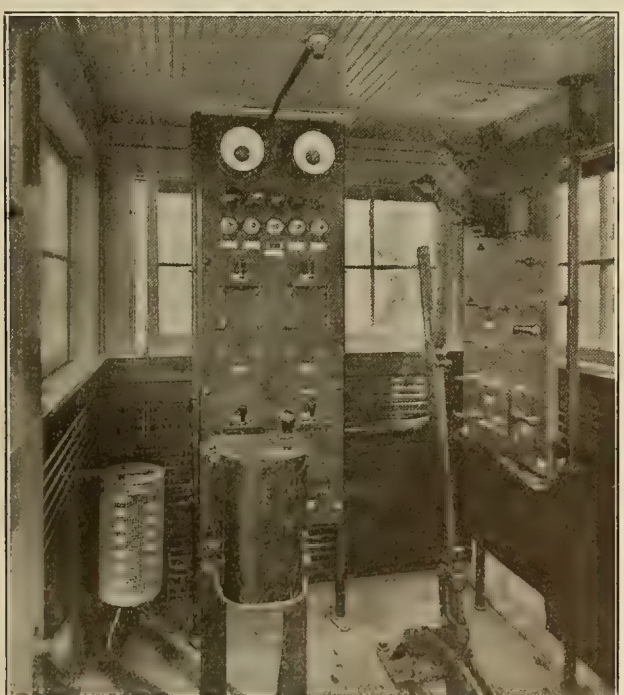
Motors are direct connected to a train of gears in the machinery house from which runs two 8 in. shafts to each side of the span. On the ends of these shafts are located the drums around which the "up-haul" and the "down-haul" cables are wound, and so arranged that as one unwinds the other winds up, both using the same grooves. These cables are 1¼ in. flexible steel. Sixty-four 2 in. flexible steel cables support the span passing over 10 ft. sheaves with 18 in. shafts located on top of the supporting towers of the bridge. The equalizer to which these cables are

attached at the counter-weights gives equal tension on all cables at all times. This is the chief patented feature of the bridge and is the feature that has made the vertical lift bridge a success.

The machinery house contains, besides the gearing mentioned, the following: A mechanically operated limit switch, which cuts off the current and sets the solenoid brakes when the span is 6 ft. from the top or bottom of its travel, one slate panel on which is mounted one 500 amp. D. P. D. H. fused service switch, one 100 amp. D. P. D. T. fused switch, one 100 amp. S. P. S. T. fused switch, one overload relay and the 10 main relays. The grid resistances are located at the rear of this board.



The Machinery House Containing the Motors and Gearing, the Limit Switches, the Relays and Resistances.



The Operator's House in Which is the Controller, the Mechanical Height Indicator, the Hand Brake and Two State Panels.

The operator's house contains the controller, the mechanical height indicator, the hand brake, and 2 slate panels. On one of these is mounted the following: One ammeter, one voltmeter, 3 switches to control gongs, stop signals, semaphore lights, 5 pilot light receptacles and the 4 switches for the electrically operated gates. On the other panel is mounted the main feeder switches for the two motors, the main circuit breaker, push button to bridge the limit at the top and a specially constructed no-voltage release to bridge the limit switch at the bottom.

Traffic at the ends of the span is shut off by 4-35 ft. gates weighing $2\frac{1}{2}$ tons each. These gates are counterbalanced and arranged to raise 5 ft. vertically after which they make a quarter turn while raising 10 ft. and come to rest parallel to the direction of traffic, thus avoiding interfering with the trolley wires. The gates are handled by 2 horsepower motors and the operation. which requires 45 seconds, is controlled from the operator's cage. Current is conveyed by mechanical contacts located under the sidewalks. Connection is broken by lifting the span rendering it impossible to move the gates while the span is raised.

The installation and testing of the electrical machinery and devices was in charge of Davis & Hull, electrical engineers and contractors of Tacoma. The International Contract Company of Seattle, Portland and Tacoma were the general contractors. Plans were drawn by Waddell & Harrington of Kansas City, Missouri, who are the patentees of the bridge. They also supervised the erection.

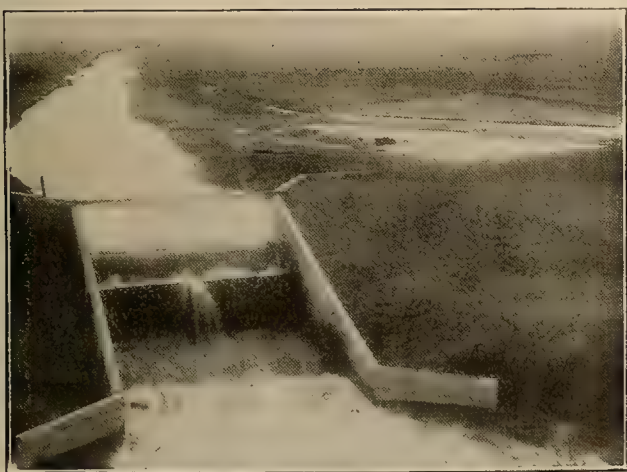
ELECTRICAL PUMPING AND IRRIGATION

CONCRETE DROPS, BAFFLE WALLS AND NOTCH DROPS.

BY B. A. ETCHEVERRY.

Modesto Plain concrete drop.

This drop is on the main canal of the Modesto Irrigation District which has a maximum carrying capacity of 630 cu. ft. per second. This structure was constructed in 1902. The drop is 15½ ft. high. The crest of the weir is 24 ft. wide and is made narrower than the canal to check the velocity above the drop. In addition 3 T beams (4.5 in. x 3 in., 85 lbs. per ft.) 9 ft. long divide the space above the crest between the two side walls into four openings regulated by flashboards 6 ft. long which permit using the drop for a check gate. These T beams are placed on a slope of 2 ft. horizontal to 1 ft. vertical and have the lower end imbedded in the crest while the upper end



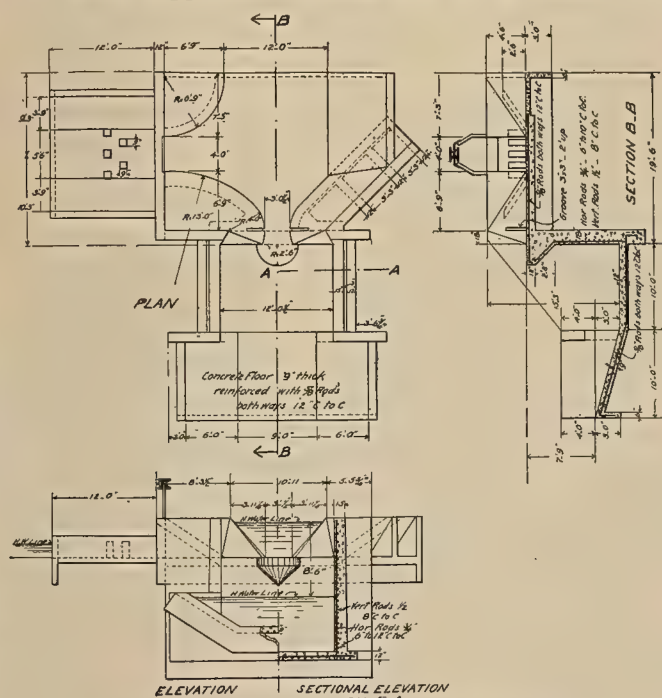
Drop with Baffle Wall, Comanche Canal, Colorado.

rests on an 8 in. I beam (18 lb. per ft.) 26 ft. long, imbedded for 1 ft. on each side wall and acting as a brace for these walls. To resist the shock of the falling water a water cushion 4 ft. deep and 12 ft. long is formed by a vertical wall 4 ft. high above the floor of the drop.

This structure was probably one of the earliest concrete drops built in this country and has worked very satisfactorily. The amount of concrete used was 330 cu. yards. Comparing the amount and cost of material for this structure with that of the reinforced drop on the same canal previously described, shows the advantage in favor of reinforced concrete. The total unit cost of construction for the reinforced drop including excavation, puddling, etc., was $15.20 per cu. yd. of concrete. Subtracting $1.70 per cu. yd. for the steel and 50c per cu. yd. for placing the steel gives the cost of plain concrete $13 per cu. yd. At this price the cost of 330 cu. yds. in the plain concrete drop is $4300. The cost of the reinforced drop was $2760. The fall, however, is not as great as for the plain concrete drop.

Drop with baffle wall, Comanche Canal, Arkansas Valley Sugar Beet & Irrigation Land Company, Colo.

This structure was constructed on the Comanche canal which has a carrying capacity of 450 cu. ft. per second, in the winter of 1907. The width of drop between side walls is 18 ft. and the height of the fall is 9 ft. The upstream wing walls run into the banks of the canal on an angle of 30 degrees with the axis of the canal. The downstream wing walls make an angle of 45 degrees with this axis. All wing walls extend below the grade of the canal to a depth of 7 ft. and prevent the water from washing under or around the structure. To break the force of the falling water, in addition to the water cushion 7 ft. deep, a baffle wall which acts also as a strut between the side walls, and against which the water strikes, has been provided. On the center line of the drop a buttress wall 6 in. thick supports the breast and baffle walls. The



Notch Drop, North Platte Project, Nebraska.

top of the baffle wall is tied to the crest of the breast wall with 1⅛ in. rods spaced 18 in. apart. The walls have all a light section and are well reinforced. The wing walls are only 9 in. thick at the bottom, tapering to 5 in. at the top and rest on a base 2 ft. 9 in. wide. The side walls are braced by the baffle wall extending between them and are of the buttress type. They are from 7 to 10 in. thick at the bottom and taper to 5 in. at the top. The floor of the water cushion consists of a series of arches 6 in. thick at the crown, well reinforced with ⅜ or ½ in. bars spaced 8 in. apart in both directions. The downstream floor is 5 in. thick and rests on reinforced concrete beams supported on reinforced concrete posts.

With the deep water cushion the baffle wall does not seem necessary. Many drops have higher falls, shallower water cushion and designed for larger quantities of water have been in successful operation for several years and depend entirely on the water cush-

ion and rip-rapping below to prevent scouring. The engineer of this company, however, states that the baffle wall breaks the force of the water more successfully than where the water cushion alone is depended on.

The itemized cost of construction is given below and the data should be valuable in preparing estimates of cost of similar structures built up of thin walls carefully reinforced. The expensive form construction and the large amount of reinforcement are partly balanced by the smaller amount of concrete. The total cost of the reinforced concrete in place was $20.073 per cu. yd. The cost of steel reinforcement in place and of the form amounts to $12.65 a cu. yd.

Classification. Excavation.	Quantity.	Unit Cost.	Total Cost.	Totals
Building dikes and ditches for controlling water during construction			$ 72.25	
Tearing out old wooden structure; cost $34.50, less material sold, $25			9.50	
Rock excavation	30	.752	22.56	
Earth excavation	253	.49	123.89	$ 228.20
Concrete				
Cement at R. R. station		2.735	246.18	
Hauling cement 4 miles		.315	28.34	
Hauling sand and gravel		1.043	93.87	
Lumber delivered at job		2.186	196.71	
Building forms		4.892	440.25	
Nails and wire in forms		.181	16.28	
Reinforcing steel at R. R.		3.268	294.11	
Hauling steel 4 miles		.302	27.15	
Cutting, bending and placing steel		2.005	180.43	
Mixing and placing concrete		2.417	217.52	
Protecting concrete from freezing		.730	65.71	$1,806.55
	90	20.073	1,806.55	
(Cost of material $711.48 = 7.905 per cu. yd.)				
(Cost of labor $1005.07 = 12.167 per cu. yd.)				
Backfilling and puddling	540	.455		$ 240.36
Equipment—				
Use of tools and equipment			146.96	
Camp expenses, including hauling and setting up of camp outfit			153.93	300.89
Engineering—				
Design and supervision of construction				229.88
				$2,805.88

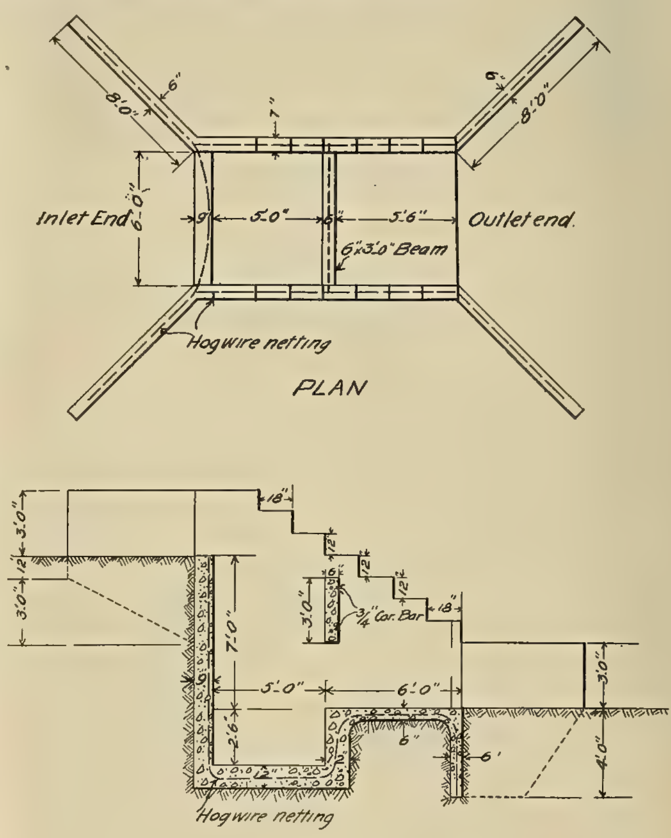
Notch drop, Herth Platte Project, Nebraska.

This drop is interesting for the reason that it represents the type of drop extensively used in India where it has been found to give very good results in preventing increased velocity above the fall and erosive action below the fall. The structure is a drop on one of the laterals of the Interstate Canals and combines with its headgate to a secondary lateral. The notch is formed in the breast wall which extends up to high water level. A groove for flashboards is formed in the notch to check the water above. The drop is designed for 136 second ft. For larger quantities of water two or more notches should be used. The approach to the notch is formed by a reinforced concrete floor and the sloping banks which are lined with 6 in. of concrete. On one side the sloping wing wall is supported on buttresses. On the other side is the gate and outlet to the secondary lateral. The outlet channel is a portion of the lateral lined with concrete with a toe wall at the lower end. Five concrete posts in this channel check the high velocity of the water as it escapes through the gate. At the floor of the notch a lip or projection spreads the water as it escapes into a fan-like sheet whose erosive power is very much less than that of falling water. Below the notch the depressed floor and a lined section of the canal form a shallow water cushion and prevent the erosion of the canal.

The cost of this structure, which is a combination drop and turnout structure containing 89 cu. yds. of concrete, was $1468.18. The total cost of five other drops of the same kind on the same canal containing a total of 323 cu. yds. was $4513.62 or $12.92 a cu. yd. Following is the itemized cost of one of these drops 4.9 ft. high and containing 66 cu. yds. of concrete:

Item	Total cost.	Cost per cubic yard
Excavation and backfilling	61.45	.931
Material haul	18.84	.285
Moving equipment	12.06	.182
Carpentry	53.20	.805
Sand	70.77	1.072
Gravel	130.54	1.978
Water	13.25	.201
Cement	144.49	2.189
Reinforcement	76.91	1.165
Concrete (mixing and placing)	85.98	1.302
Lumber	70.62	1.070
Total	$737.11	$11.18

Sand and gravel were hauled 3½ miles, water 2½ miles, cement and steel 6½ miles; carpenters were paid 45c an hour, laborers 30c an hour.



Details of Seven Foot Drop on Carlton Lateral, Colorado.

The success obtained with this type of drop indicates that it is probably superior to the other types and should be more extensively used.

Small Standard Drop; American Beet Sugar, Co., Colo.

This design of drop is used on ditches having a capacity of 5 to 75 cu. ft. per second. The dimensions which are constant for the different sizes of drops are shown on the drawing while the variable dimensions are given in the table. The capacity table gives the discharge for different widths of box for depths of water in the ditch of 1 ft, 1 ft. 6 in., and 2 ft. While outlet wings are usually not required for the smaller boxes, if necessary the banks may be protected with riprap or a line of posts and woven wire strung on each side of the ditch. The larger drop boxes should have a special outlet end designed to suit the conditions as they are found to exist. The walls are reinforced with strands of barb wire every 6 in. in their height. This reinforcement is intended mainly to tie the walls together. The drawing shows the form in place for the construction of water cushion box and for the side wall. At the inlet the wing wall should extend at least 1 ft. below the bottom of the ditch to prevent the washing around the structure.

The instructions to be followed in construction are as follows: Where the soil is sufficiently rigid and compact to rigidly make the excavation no outside forms will be required unless it be for the portion of the wall extending above the ground. After the excavation is completed fill with concrete up to the surface of the floor of water cushion, then put in place the form for the water cushion box and fill the side wall spaces with concrete up to the lower grade of the canal. Now set the forms for the side walls and the down stream face of the crest wall. The concrete can now be filled in up to the height of crest, then finish the side and wing walls to the desired height.

Walls 2 ft. high may be made 6 in. thick; over 2 ft. and under 4 ft. walls may be 8 in. thick; and for greater heights the walls should be at least 12 in. thick or heavier reinforcement used. If many of the boxes are to be built the forms should be made of 2 in. lumber, especially for the side walls. When using the forms for the second time or afterward, clean off all mortar adhering to them. This will aid in making a smooth surface wall. When through with the forms they should be carefully stored to prevent warping. The cost of constructing a 3 ft. drop 3 ft. wide was as follows:

7 sacks of cement at 65c	$4.55
2 yards of sand at 75c	1.50
Labor 1 man 1 day	2.50
Labor. 1 man 1 day	2.00
	$10.55

The walls were 8 in. thick although 6 in. would have been sufficient. The cost of form is not taken into consideration as it is used over again several times.

ELECTRIC CRANES IN ARGENTINE.

The government has accepted the tender of the Machinenfabrik Augsburg, Nurnberg, A. G., for the supply of 75 electric cranes for the warehouses in the Port of Buenos Aires at $1150 gold each, and 6 sets of spares at $530 each.

POWER COSTS FOR MINING.

An excellent comparison of the comparative cost of steam, gas or hydraulic power for driving alternators is contained in a paper on the electric power installation at El Tigre Mine in Mexico, presented by James W. Malcolmson at a recent meeting of the American Institute of Mining Engineers. An enlargement of the mill required that a new source of power be found, as fuel for an existing steam and producer gas plant had become scarce and expensive. It was estimated that the enlarged plant, together with the mine, would require 750 h.p.

In a study of the best manner to obtain power the following alternative propositions were considered:

1. To continue using the local fuel supply by building tramways and cheapening transportation generally, thereby reaching a larger area of country. Power to be generated by means of wood-burning gas-producers and gas engine plant.

2. To build a steam power plant at Yzabal, the nearest railroad point, 30 miles away, and transmit electric power to the mine, using Texas or California oil as fuel at $1.70 (U. S. currency) per barrel on the assumption that the Mexican government would remove the import duties.

3. To build a dam on the Bavispe river, 10 miles from the mine, and install a hydroelectric plant and transmission line.

4. To install a power plant at Douglas, Arizona, and transmit electric power 65 miles to the mines.

An investigation of the available timber showed that it consisted of 80 per cent of white pine and 20 per cent of scrub oak. The supply was limited and much of the pine would be required during the next ten years for mine timbering and general construction work.

It is estimated that 13,500 cords of wood, 8 x 4 x 3 ft., would be required, per annum, to produce 750 h.p. in a well designed gas engine plant, as follows:

	Horsepower Hours per Annum.	Consumption per H.P.hr. Pounds.	Total Quantity per Annum. Pounds.	Per Cord. Pounds.	Total per Year. Cords.
White dry oak.	1,600,000	3.3	5,280,000	2.020	2,000
Dry pine	4,800,000	3.0	14.400,000	1,326	10,900
	6,400,000		19,680,000		13,500

Estimating these 13,500 cords at $3.25 per cord equals a total of	$43,875
per annum. Add coke used in the bottom of the producers, 1⅛ per cent of the weight of the wood consumed, equals 150 tons per annum at $20 per ton, equals per annum	3,000
Total fuel cost (U. S. currency)	$46,875

A well designed steam plant at Yzabal with electric power transmission to El Tigre would consume 1.5 lb. Texas fuel-oil per horsepower delivered to the motors. Taking 750 h.p. for 365 days equals approximately:

6,400,000 hp.-hr. at 1.5 lb	9,600,000 lb. of oil
311 lb. of oil per barrel equals	30,870 barrels of oil
$1.70 per barrel at Yzabal gives total fuel cost per annum (U. S. currency)	$52,480
Excess cost over gas fuel at the mine	5,605

This difference would be wiped out by an increase of 50c per cord in the cost of 13,500 cords per year. In fact, before the new power plant was in operation the price of cordwood had increased $1 per cord and the cost under any circumstances would have steadily risen.

Even with wood at $3.25 per cord the estimated saving was more than offset by the greater expense for labor, repairs and supplies with gas engines.

In a plant of this size the expense of gas power would be nearly twice as much for repairs and supplies as for the corresponding items in a steam power transmission plant. The cash expenditures per annum would be greater at El Tigre than with a steam electric plant at Yzabal, even if there were no increase in the cost of wood.

Regarding first cost, it was estimated that gas engine power is unsatisfactory unless the plant has one spare engine to allow for the periodical cleaning of each engine in turn.

It was estimated that a suitable plant of gas-producers, gas engines and dynamos could only be installed at El Tigre, 30 miles from the railroad, for $150,000, taking the European cost of engines. Engines made in the United States would cost more.

The first cost of a suitable steam plant at Yzabal with electric power transmission to El Tigre was estimated at $213,400, including economizers, as follows:

Power plant at Yzabal erected complete	$133,000
Economizers (not considered important)	17,000
Transmission line to El Tigre, 30 miles, 30,000 volts	30,000
Step-up and step-down transformers	14,000
Margin on a preliminary estimate, 10 per cent	19,400
Total estimated cost	$213,400

The estimated cost of delivered horsepower per year using 750 h.p. was $105.

Compared with power transmitted from a steam plant at Yzabal, gas engine power at El Tigre would be less reliable, and more troublesome, and the proposition to install a local power plant at the mine was, therefore, definitely rejected.

After an expert examination of a proposed dam on the Bavispe River, this proposal was also abandoned. The river is usually 150 ft. wide and 2 ft. deep, but at times it is 2000 ft. wide and 24 ft. deep, and during dry seasons the river is not over 6 in. deep. If a dam and power plant were built, except at enormous cost and many miles away, a duplicate steam plant would also be necessary and the total estimated cost proved to be out of all proportion, when compared with the other projects.

Before finally deciding to build the plant at Yzabal, which is 45 miles south of Douglas, an investigation was made as to the possibility of securing power from that town. In Douglas, the power plant of the Copper Queen Consolidated Mining Company develops approximately 5000 h.p. for the requirements of its smelter. An arrangement was made whereby this company agreed to install exhaust turbine generators in its plant and supply electric power to the Tigre Mining Company. The installation was to be paid for by the Tigre Mining Company, and the power sold on a sliding scale varying with the amount taken and the cost of fuel oil in Douglas. In August, 1912, this amounted to 0.96 cent per kw.-hr. at Douglas.

The installation of an exhaust turbine plant at Douglas presented several advantages, although the cost of the machinery, together with the 65 mile transmission line to the mine, was considerably in excess of the Yzabal proposition with a 30 mile transmission.

The principal advantage, which led to a final decision to adopt the Douglas proposal, was the cost of power.

Taking 750 h.p., it was estimated that a plant at Yzabal would cost per annum $79,000, or $105 per horsepower delivered at El Tigre per year.

Power from Douglas delivered at the mine, it was estimated, would cost slightly more than $70 per horsepower per year, or from $54,000 to $57,000 per annum, depending on whether one or two turbines were required.

In other words, the Douglas proposal showed a saving in cost of power of $25,000 per year, and it was decided in July, 1910, to adopt it and build a line to the mine.

In June, 1911, power was delivered over the line to El Tigre, the revolution in Mexico causing some delay in prosecuting the work.

The plant at the works of the Copper Queen Consolidated Mining Company in Douglas consists of two 750 kw. exhaust turbine generators which will operate with a 50 per cent underload or overload without any very serious loss of efficiency. The Tigre Mining Company receives the power at the bus bars at a tension of 2200 volts. This is stepped up to 44,000 volts by means of three General Electric transformers. At the mine the current is stepped down to 440 volts and distributed to the various circuits in the plant.

The transmission is peculiar on account of the small quantity of power being transmitted such a long distance.

The line is a 44,000 volt, 60 cycle, 3-phase line consisting of a single line of wooden poles carrying three conductors of No. 4 B. & S. gauge medium hard drawn copper with telephone wires below. The poles are spaced 200 ft. apart; and at the crossing of the Bavispe River, the span is 1600 ft.

The cost of the line from the low tension side of its step-up transformer station at Douglas to the low tension side of its step-down transformer station at El Tigre was $161,121. Not including the transformer stations at each end the cost was very closely equal to $2000 per mile. The line, including the transformer stations, was built by Messrs. Sanderson & Porter of New York.

The total cost of the exhaust turbine generator plant, including the steam piping, etc., was $71,894, the machinery being installed by the Copper Queen Consolidated Mining Company.

During the past year 6000 tons of ore have been concentrated and 7500 tons cyanided monthly at the Tigre mill. An average of 616 h.p. is distributed at the El Tigre switchboard at a cost of $86 per horsepower per year; the cost at Douglas being 0.95 cent per kilowatt-hour.

ACCOUNTING UNDER UTILITY REGULATION

MAINTENANCE OF CAPITAL. II.

BY JOHN A. BRITTON.

Maintenance of capital includes those mechanical or physical changes in the fixed capital which primarily affect the results of current operations rather than the value of the facilities, structures or units of equipment. These changes are made to keep the facilities, structures, or units of equipment in as good working order as they were originally expected to be, after the lapse of time which intervenes between the date of acquisition, and that on which these changes have been made. The charges which are made to capital under the general heading of **Maintenance of Capital** are generally termed repairs, and are thereby more specifically designated as expenditures necessary to keep the facilities, structures or units of equipment, up to the standard of operating efficiency.

This term should therefore not be applied to any changes of capital which result in new facilities, structures or units of equipment of the same or greater capacity, or which amount to a substantial change of identity in such facilities, structures or units of equipment.

When through wear and tear, or through casualty, it becomes necessary to replace or repair some part of any structure, facility or unit of equipment, and the extent of such repairs does not amount to a substantial change of identity in such structure, facility or unit of equipment, such work is to be treated as a repair, and charged to the sub-accounts under maintenance.

Replacements include all substitutions for existing structures, facilities or units of equipment, which have been exhausted or become inadequate in service; and when the replacement of such structures, facilities or units of equipment does not increase the capacity, then the cost of such structures, facilities or units of equipment must be considered as a replacement, and not charged to any of the sub-accounts under maintenance, but to Accrued Amortization of Capital, (a general account). When a substitution for existing structures, facilities or units of equipment has a substantially greater capacity than that structure, facility or unit of equipment for which it is substituted, the value of the original structure, facility or unit of equipment, less the salvage of old material, as junk or stock, shall be charged as a replacement and credited to capital; the cost of the substituting structures, facilities or units of equipment shall constitute an addition and betterment to capital, and be charged to appropriate sub-account in Additions and Betterments of Capital, (a divisional account).

Repairs have to do with the replacement of parts of existing structures, facilities or units of equipment, as, e.g., replacing a spoke or wheel of a wagon or automobile; valve or cylinder rings of an engine; field coils or collection rings of a generator, etc. Replacements have to do with the total discarding of existing structures, facilities or units of equipment, and the substitution of one of same or greater capacity, as, e. g., a gas generator is burned out and cannot be repaired, it is junked and a new generator installed in its place; if a gas generator is burned out and cannot be repaired and is replaced by a generator of twice the capacity, then the original cost of the discarded generator, less salvage, as scrap or stock, would constitute the replacement, and the cost of the generator of greater capacity, less the replacement, would constitute a betterment.

Case I.

Replacement:

1—Gas Generator (original machine)	$25,000.00
1—Gas Generator (replacing original machine)	25,000.00

No charge to capital or increase of capacity, therefore the second machine is a replacement.

Case II.

Replacement and Betterment:

1—Gas Generator (original machine)	$25,000.00
1—Gas Generator (replacing original machine)	35,000.00
An addition to capital and an increase in capacity, therefore a betterment	$10,000.00
Original value of replaced machine	25,000.00
Salvage charged to M. & S. and credited to capital	1,000.00
The replacement charge	$24,000.00

All repairs of capital devoted to the production of gas, the transmission thereof to consumers for light, heat or power, and all capital incident thereto, including the collection of revenues therefor and the disposition of by-products produced in connection therewith, shall be termed Maintenance of Gas Department Capital.

Maintenance of Gas Department capital is divisible into: maintenance of general capital, maintenance of generating capital, maintenance of transmission capital, and maintenance of distribution capital.

Maintenance of General Capital.

Charge to this account the cost of all repairs to:

(1) **Structures of a permanent character,** devoted to joint purposes of the Generating, Transmission and Distribution Departments, which cannot be included in any of the departmental accounts; also all repairs of fixtures permanently attached thereto, and made a part thereof, such as water pipes and fixtures, steam pipes and fixtures for warming and ventilating, gas pipes and fixtures for lighting, etc.; elevators, etc., and the engines and motors specially provided for operating them; furnaces, boilers, etc.; electric wiring and fixtures for lighting, signaling, etc.; electric generators specially provided for producing current for lighting such buildings, etc. This account includes such repairs of piers and other foundations for machinery and apparatus, as are designed to be as permanent as the buildings in (or in connection with) which they are constructed, and to outlast the first machinery or apparatus mounted thereon; also all repairs of fire protection equipment; fences, walls, sidewalks and pavements within the limits of the grounds and immediately adjacent to such buildings.

Among such building repairs chargeable to this account are office buildings, barns, storehouses, machine and blacksmith shops, etc. Do not include re-

pairs to any part of departmental power plant buildings, substation buildings, general structures, works and station buildings, unless such part as used jointly by above mentioned departments, is separately attached thereto.

(2) **Tools and appliances,** which are used jointly by the Generating, Transmission and Distribution Departments. This account includes the cost of all repairs to tools and appliances, and includes the cost of such tools as are not listed in the Equipment Record. These charges should include repairs to machine tools, such as planers, lathes, drills. punches, shears and like machine shop equipment; also blacksmith shop equipment, such as forges, anvils, blowers, bellows, etc.

Include the cost of all hand and portable tools, which are not listed in tool register as to location and number.

(3) **Wagons and harness,** which are used jointly by Generating, Transmission and Distributing Departments. This account should include the cost of such extra parts of wagons and harness as collars, hames, wheels, tongues, etc.; also the cost of repairs such as painting, setting tires, repairing wheels, etc., sewing harness and like repairs.

Do not include the cost of horses taking the place of existing or disabled stock; all replacements of horses must be handled through appropriate general ledger account. Whips, blankets, washing of wagons, dressing of harness, must not be included in this account.

(4) **Automobiles, motorcycles and bicycles** which are used jointly by Generating, Transmission and Distribution Departments. This account should include all repairs and all extra parts, such as tires, lamps, tops, cushions, etc.; also repairs to engines, lamps, tires, cushions, saddles, wheels, etc., and painting and decorating. Do not include the washing, oils, gasoline and like supplies for operating.

(5) **Furniture and fixtures** devoted to joint uses of Generating, Transmission and Distribution Departments. This includes repairs to desks, chairs, tables, etc., and the cost of such furniture and fixtures, as are not properly included in capital.

Maintenance of Generating Capital.

Charge to this account the cost of all repairs of:

(1) **Works and station structures,** including permanent piers and foundations. Such structures, include retort houses, generator houses, purifier houses, engine houses, boiler houses, meter houses, tar houses and wells, structures for residuals and by-products; appurtenant walks, fences, drives, tramways, etc., and all fixtures permanently attached to such structures and made a part thereof; also holder houses, except the holders and their appurtenances.

(2) **Buildings of a permanent character,** devoted solely to general purposes of the Generating Department and not includible in any of the departmental accounts; repairs of all fixtures permanently attached thereto, and made a part thereof, such as water pipes and fixtures, steam pipes and fixtures for heating and ventilating, gas pipes and fixtures for lighting, etc., electric wiring, elevators, etc., and the engines and motors specially provided for operating them; furnaces, boilers, etc. This account includes such piers and foundations as are used for machinery, used as above; and such buildings as office, storehouses, barns shops, etc.

Do not include in the last two foregoing accounts repairs of any structures and buildings not devoted solely to uses of Generating Department.

(3) **Boiler apparatus** and accessories, devoted to the production of steam for use in producing gas, and in furnishing motive power in gas works and stations. This includes boilers and valves thereto attached, appurtenant furnaces and grates, flues leading to smokestacks and chimneys, and the specially provided foundations and settings of such boilers and appurtenances. It also includes repairs to mechanical stokers, oil burners and other like apparatus for regulating the supply of fuel, etc.; feed and hot water heaters and economizers, injectors, filters, feed pumps, blower engines, coal conveyors, ash conveyors, water pipes, steam traps, drains and separators, and pipes for conducting steam from the boiler to the engine, to condensers or to gas producers, exhaust pipes, etc. It does not include steam pipes whose primary purpose is the heating of buildings.

If the steam is used for prime movers in Electric Department, a proportion of the expenses should be charged to the department benefited, based on the horsepower and time operated.

(4) **All oil gas generators,** the specially provided foundations and settings for such generators, stacks, appurtenant pipes and valves attached thereto. It also includes repairs to lining, fire-brick, etc.; seals and valves attached thereo.

(5) **Water gas generators and accessories,** devoted to the production of gas, the specially provided foundations and settings for such water gas sets, and the flues and stacks. This account includes not only generators, carburetters, superheaters, seals and piping connected therewith, but oil heaters, etc.

(6) **Steam and gas engines** used as prime movers in gas works; likewise the specially provided foundations and settings of such engines. This includes repairs to the throttle or inlet valve, governor, condenser and air pumps, ignition and starting apparatus; all repairs to steam and gas engines, used for driving, blowers, oil and fuel water pumps, tar pumps, conveyors, etc. Do not include any repairs to prime movers of boosting equipment.

(7) **Apparatus for purifying gas,** including condensers, washers, scrubbers, purifiers, tar extractors, etc., their specially provided foundations and settings; also the pipes connecting the apparatus and appurtenant valves and gates. Do not include the cost of piping from purification apparatus to relief and storage holders; and do not include purification material.

(8) **Gas holders** and appurtenances at works, and of those at district stations. Repairs of holder housings shall be charged to account, "Repairs of Works and Station Structures."

(9) **Apparatus and accessories** not includible in any of the foregoing accounts and **not** having to do with **boosting equipment.** This includes repairs to blowers, station meters, governors, etc.; apparatus for charging retorts; oil pumps and oil meters; conveyors for disposing of coke, lampblack, other by-products

and residuals; tar and ammonia apparatus, pumps, pipes and tanks, electric motors, regulators, etc.

(10) **All fuel tanks** and bunkers used for storage of oil and coal for gas or steam. This should include repairs of appurtenant valves and pipes, from oil tanks to generator and furnace valves, conveyors for lamp-black and coal; also cost of painting.

(11) **Station piping** conveying gas from purification apparatus to relief holders to storage holders, appurtenant gates and valves.

(12) **Tools** and appliances and include the cost of such tools as are not listed in the Equipment Record. These charges should include the cost of repairs to machine tools such as planers, lathes, drills, punches, shears and like machine shop equipment; also blacksmith shop equipment, such as forges, anvils, blowers, bellows, etc. Include the cost of all hand and portable tools, which are not listed in tool register as to location and number.

(13) **Wagons and harness** and include the cost of such extra parts of wagons and harness. These charges should include the cost of painting wagons, setting tires, repairing wheels, etc., and sewing harness and like repairs.

(14) **Automobiles, motorcycles and bicycles.** These charges should include repairs to engines, lamps, tires, cushions, saddles, wheels, etc.; also painting and decorating.

(15) **Furniture and fixtures** devoted solely to uses of Generating Department. This includes repairs to desks, chairs, tables, etc., and the cost of such furniture and fixtures as are not properly included in capital.

Maintenance of Distribution Capital.

Charge to this account the cost of all repairs to:

(1) **Buildings of a permanent character,** devoted solely to general purposes of the Distribution Department and not includible in any of the departmental accounts; and repairs of all fixtures permanently attached thereto, and made a part thereof, such as water pipes and fixtures, steam pipes and fixtures for heating and ventilating, gas pipes and fixtures for lighting, etc.; electric wiring, elevators, etc., and the engines and motors specially provided for operating them, furnaces, boilers, etc. This account includes such piers and foundations as are used for machinery, used as above, and such buildings as office, storehouses, barns, shops, etc.

(2) **Mains.** This includes labor of foremen, inspectors (not house inspectors), caulkers, tappers, pavers, drillers, skilled laborers; similar workers on street department pay-rolls, while engaged in repairing, altering, overhauling, changing position of, or removing street mains; protecting exposed or undermined mains; searching for and repairing leaks in mains and paving over any of the above work; also material and cartage in connection with above work. Do not include any repairs to trunk lines.

(3) **Services.** This includes the same classes of labor as shown in account, "Repairs of Gas Mains," while engaged in repairing, altering, removing, relaying, cutting off, increasing the size of and changing searching for and repairing leaks in mains and paving over any of the above work; material and cartage in connection with work shown above.

(4) **Capital,** devoted solely to **municipal street lighting.**

(5) **Mains,** devoted solely to supplying gas for **municipal** street **lighting.** This includes repairing leaks, street surface, valves and gates; labor expended for caulkers, drillers, etc., and such other repairs as shown under account, "Repairs of Gas Mains."

(6) **Services.** This would include such repairs as described in account, "Repairs of Gas Mains."

(7) **Gas arcs.** This includes replacing parts, painting, etc., but only such repairs as necessitate taking the lamp out of service. Do not include any trimmer supplies such as globes, mantles, etc.

(8) **Stands, brackets** and other supports (except electric light poles), used for supporting lamps of the municipal street lighting system. Do not include in the foregoing sub-accounts of repairs of municipal street lighting system any repairs which are not made to capital, devoted solely to street lighting.

(9) **Regulators** and governors of district or house type. Do not charge any repairs to station regulators.

(10) **Arc lamps** devoted to **commercial** lighting. This includes replacing parts and painting. Do not include any repairs which do not necessitate the removal of the lamp from service, except painting while in service.

(11) **Meters** used in registering gas delivered to consumers. This includes new diaphragms, dials, etc., and painting. Do not include any repairs, (except painting), which do not necessitate the removal of the meter from service.

(12) **Tools and appliances** and include the cost of such tools as are not listed in the Equipment Record. These charges include repairs to machine tools, such as planers, lathes, drills, punches, shears, and like machine shop equipment; also repairs to blacksmith shop equipment, such as forges, blowers, bellows, etc. Include the cost of all hand and portable tools which are not listed in tool register, as to location and number.

(13) **Wagons and harness.** These charges include painting wagons, setting tires, repairing wheels, etc., sewing harness and like repairs.

(14) **Automobiles, motorcycles and bicycles.** These charges should include repairs to engines, lamps, tires, cushions, saddles, wheels, etc.; also painting and decorating.

(15) **Furniture and fixtures** which have been charged to capital accounts. This should include revarnishing, etc.

CAMELS FOR POWER IN ARGENTINA.

The Argentine government has had under consideration the possibility of the importation of camels into the country for use in agriculture. The concrete result of this consideration is a decree, date of December 24, 1912, in which are laid down the inspection and quarantine requirements that must be observed in case camels are imported. It was brought to the attention of the government that camels might well be utilized to advantage for various agricultural labors in certain semi-arid regions of the country, where vegetation and water are scarce, to take the place of the horse and the ox.

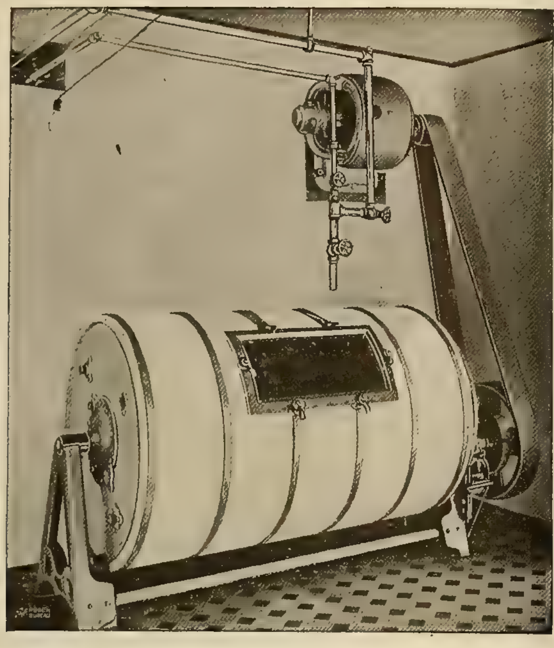
READINESS TO SERVE METHODS

RATES FOR AGRICULTURAL SERVICE.

BY ROSS B. MATEER.

Many corporations still cling to the necessity of a meter for each class of service, irrespective of the expense occasioned for cheap and accurate apparatus, forgetting the small amount of revenue received annually on over 60 per cent of the capital sunk in the purchase of small measuring devices, upon which investment the yearly receipts are rarely sufficient to the annual energy loss in the small kw.-hr. meters, while the consumer will be instructed to install only apparatus of low maximum demand, the operation of which over longer periods of time results in lower unit kw.-hr. costs.

What is more efficient to the one occasions less investment expense to the other, hence, the considera-



Uniform Low Rates Make Possible Unlimited Electrical Application Upon the Farm—The Wringer the Churn, the Sewing Machine and the Ice Cream Freezer Being Typical Illustrations.

pay the charges incident to capital and maintenance. Education is necessary today, for some central stations, though of a different character from that needed by the average consumer. The former must learn to secure business on rates based on load factor, and to use one meter at one point of delivery for all current consumed, for lighting, power and heating purposes, eliminating tion of load factor, and where possible, power factor in the determination of unit rates is of mutual interest. Co-operation between patron and utility in arriving at an equitable charge per kw.-hr. based on load factor is the keynote to success for any central station. No longer can evening peaks be given as a reason for high lighting rates, as all light and power companies have

contracted for and connected to their lines, sufficient power load to make the lighting peak a spectre of the past.

Simplicity is the road to success where electric service is designed to compete with other fuels and illuminants, and it is firmly believed the best method of charging for current, metered at one point, for all agricultural purposes is in accordance with the schedule appended:

3.0c per kw.-h. if monthly consumption is less than	31 kw.-h. per H.P.....
2.9c " " " " "	" from 31 to 42 " " "
2.8c " " " " "	" " 42 to 55 " " "
2.7c " " " " "	" " 55 to 70 " " "
2.6c " " " " "	" " 70 to 86 " " "
2.5c " " " " "	" " 86 to 105 " " "
2.4c " " " " "	" " 105 to 124 " " "
2.3c " " " " "	" " 124 to 146 " " "
2.2c " " " " "	" " 146 to 169 " " "
2.1c " " " " "	" " 169 to 194 " " "
2.0c " " " " "	" " 194 to 221 " " "
1.9c " " " " "	" " 221 to 250 " " "
1.8c " " " " "	" " 250 to 280 " " "
1.7c " " " " "	" " 280 to 312 " " "
1.6c " " " " "	" " 312 to 346 " " "
1.5c " " " " "	" " 346 to 381 " " "
1.4c " " " " "	" " 381 to 418 " " "
1.3c " " " " "	" " 418 to 457 " " "
1.2c " " " " "	" " 457 to 498 " " "
1.1c " " " " "	" " 498 to 540 " " "
1.0c " " " " "	" 540 kw.-h. per h.p.

This schedule is for all agricultural power, including irrigation and reclamation, and the rate and minimum charge shall be based on the maximum demand of the consumer's apparatus and not on the rated h.p. in motor or motors installed. The maximum demand shall be determined by a test or tests made from time to time by the company as they may elect, and each 750 watts as shown by these tests shall constitute a h.p. for the purpose of this schedule. The consumer is entitled to have a representative present at any and all tests made for this purpose, and may have tests made by the company at his request to determine the maximum demand, provided ten days' notice is given the company, and provided that no more than two such tests shall be requested per year. The maximum demand as determined by any test shall remain in full force and effect until the next succeeding test, and the result of any such succeeding test shall be effective only from and after such test and until the next succeeding test.

The minimum charge is $6 per h.p. per year.

Increased use, efficient apparatus, low demand, application of electricity to all agricultural purposes, are a few of the benefits of the above described load factor method of charge for monthly consumption.

The optional rate offered by a few power companies ranges form $35 to $50 per year per h.p. but this method results in the abuse of the commodity by the consumer, the installation of demand limiting devices, at the expense of the utility, and the creation of a false standard of value for electric energy.

Flat rates per h.p. are a survival of the errors of early days, while a straight charge per kw.-hr. is generally the result of vague ideas of the factors entering into generation, distribution, etc.

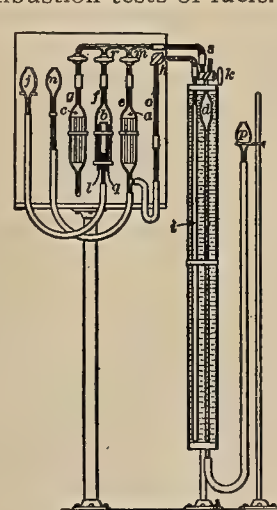
Only recently has some attention been given to rates based on load power factor, though like leaven it will imbue all utilities with a desire for an accurate determination of production costs and consequently a fair and equitable tariff to the consumer.

APPARATUS FOR THE EXACT ANALYSIS OF FLUE GAS.

BY GEORGE A. BURRELL AND FRANK M. SEIBERT.

In the course of its tests of fuels belonging to and for the use of the government, the Bureau of Mines has had occasion to study carefully the methods of determining the composition of the flue gases of a boiler under the varying conditions of a steaming test. This paper describes gas analysis apparatus that has been used in tests conducted by the bureau as detailed in Technical Paper No. 31.

The exact analysis of the combustible constituents in flue gas has received little attention, largely because of the difficulty of readily determining the small quantities usually present of these constituents. The literature on the subject contains meager information relative to the percentages of hydrogen and methane in flue gas, the constituents usually determined being carbon dioxide, carbon monoxide, and oxygen. It is the hope of the authors that the apparatus described in this paper may prove useful to engineers and chemists who have occasion to direct or take part in combustion tests of fuels.



Laboratory form of Apparatus for the Exact Analysis of Flue Gas.

Many manufacturing concerns have apparatus for determining a few of the constituents of flue gas. Some employ automatic devices for CO_2 recording; others collect samples at intervals or during extended periods of time and analyze them by means of various types of gas analysis apparatus, such as those devised by Orsat, Hempel, Elliot and Bunte. With any of these apparatus results can be obtained by which the performance of a boiler furnace can be intelligently supervised, but when the exact composition of the waste gases is desired, as in technical research, they are not sufficiently accurate. Under ordinary circumstances, as little as 0.10 per cent of unburned combustible gases passing through the flue may be equivalent to the loss of about 1 per cent of the fuel fed into the furnace. It is recognized that in boiler practice there are other heat losses greater than those occasioned by incomplete burning of combustible gases, but the fact remains that the extent of the losses due to incomplete combustion has not been exactly determined. The apparatus most used for the examination of flue gases is the Orsat. The smallest percentage that it will in-

dicate is probably 0.10 or 0.20 per cent, so that the results obtained with it do not have much significance if an exact analysis is sought. With the Orsat apparatus carbon monoxide is determined by means of an ammoniacal or acid solution of cuprous chloride, and the apparatus is not altogether satisfactory for the determination of the small quantities of this constituent found in flue gases in ordinary furnace practice. The determination of the hydrogen or methane is seldom attempted.

Special Apparatus for the Analysis of Flue Gas.

For the determination of carbon dioxide, oxygen, carbon monoxide, hydrogen, and methane in flue gas during combustion tests conducted by the Bureau of Mines the authors have used the apparatus shown in Fig. 1.

This apparatus is a modification of the well known Haldane apparatus. It has been simplified from the original pattern in that the pipettes are all placed in a common train. Three 3-way stopcocks have been replaced by three 2-way stopcocks, and a simpler pipette has been provided for the alkaline pyrogallate solution. The essential features and the method of working remain the same as proposed by Dr. Haldane for analyzing mine air. The apparatus is so well adapted for the exact analysis of flue gas that attention is here called to such use.

The apparatus and its use are described by reference to the figure. The burette, d, contains mercury and has a total capacity of 21 c.c. The bulb of the burette, which is not graduated, has a capacity of 15 c.c. The stem of the burette has a capacity of 6 c.c. and is graduated to 0.01 c.c. The three pipettes shown are the potassium-hydroxide, a; the slow combustion, b; and the alkaline pyrogallate, c. The reservoir of the alkaline pyrogallate pipette is placed back of the stand and is provided with a rubber bag to prevent access of air to the alkaline pyrogallate solution.

The surfaces of the liquids in the reservoir bulbs must, in all cases, be at the same level as the surfaces of the liquids in the corresponding pipettes when the liquids are brought to the marks represented at e, f, and g in the figure. This condition is necessary to prevent a difference in pressure acting against the columns of the liquids in the pipettes when the gas sample is transferred from the burette to the different pipettes.

To perform an analysis, the liquids in the three pipettes are brought exactly to the marks e, f, g, on the capillary tubes. If an analysis has been recently made, this preliminary step is unnecessary, but if the apparatus has stood unused for some time, the solutions usually have to be adjusted before making an analysis. The three-way stopcock h is turned to communicate between the outside air and the compensating tube i, so that the pressure in the tube may equal that of the atmosphere, and is then turned to communicate between the tube i and the column of liquid in the capillary tube o. The gas sample is transferred to the burette by displacing it with mercury.

The first 5 or 10 c.c. of gas drawn into the burette d from the sample container is not retained, but is used to sweep the air out of the connections between the burette and the sample contained. For this purpose an extra 3-way stopcock is placed between the burette and the sample container. Gas is then drawn into the burette until the mercury is depressed somewhat below the 21 c.c. mark; then, with the burette stopcock k closed, the gas is placed under pressure by slightly raising the level bulb p. Next the burette stopcock k is opened to the air for a second to bring the gas in the burette to atmospheric pressure. Before reading the volume of gas inclosed, the stopcocks at k and m are turned so that communication is made between the burette and the potassium-hydroxide solution pipette a.

If the directions for manipulating the apparatus have been followed with care there is only a slight movement of the potassium-hydroxide solution at e. If, through failure to follow directions exactly, there is a decided movement of the solution, error will ensue. A resulting increase of pressure causes an absorption of some carbon dioxide before the reading is taken, and a decrease of pressure pulls the potassium-hydroxide solution into the horizontal capillary tubing, thereby ruining the value of the combustion data subsequently obtained.

By slightly raising or lowering the level bulb n the surface of the potassium-hydroxide solution is brought exactly to the mark o in the capillary tube.

The potassium-hydroxide solution is brought to the mark e above the pipette by a slight movement of the mercury in the burette, and the volume of gas is read to the third decimal place. The burette can be read to 0.00 c.c. The gas is then passed into the potassium-hydroxide pipette, and the carbon dioxide is entirely removed by passing the gas back and forth between the burette and the potassium-hydroxide pipette about four times. In no case should the mercury in the burette be raised above the stopcock k. The reduction in volume of the sample caused by the removal of the carbon dioxide is recorded.

The sample is next passed into the slow combustion pipette b. The platinum coil in this pipette is No. 30 (B. & S.) wire and is in contact with platinum wires in two glass tubes filled with mercury. Each wire is sealed through the bottom of its tube and to the projecting ends are attached the copper wires for carrying the electric current. The platinum coil is brought to a white heat by a current of about 5 amperes. About two minutes is required for the complete oxidation of the combustible gases contained in the sample. The gas remaining in the capillary tubing is brought in contact with the platinum spiral by passing the sample back and forth between the burette and the combustion pipette several times, care being taken that the mercury in the combustion pipette is not raised to the platinum spiral in the pipette. Finally, the current is broken and the pipette allowed to cool. Cooling is hastened by playing a stream of compressed air upon the pipette. When cool, the gas is transferred to the burette and the contraction in volume is recorded.

The residual gas is then passed into the potassium-hydroxide pipette a to absorb the carbon dioxide produced by the combustion. After the contraction in volume caused by this absorption has been measured, the gas is passed into the pipette c containing the alkaline pyrogallate solution to absorb oxygen.

At this stage of the analysis the capillary tubes are manifestly filled with residual gas that contains oxygen. In order to avoid sweeping them out by dilution and to obtain the last trace of oxygen, the mercury in the combustion pipette is brought to the stopcock r by raising the bulb j and the potassium-hydroxide solution is brought to the stopcock m by raising the bulb n. The oxygen is completely absorbed by passing the gas back and forth between the burette and the alkaline pyrogallate solution five or six times.

The alkaline pyrogallate solution is finally brought exactly to the mark g; the mercury and the potassium-hydroxide solution are brought to their respective marks at f and e, and the reduction in volume of the gas is measured. The oxygen percentage thus determined represents the oxygen, remaining after a certain volume has been consumed in the burning of the combustible constituents. To determine the volume of oxygen consumed, a separate determination is made by drawing a fresh portion of the sample of gas into the burette and passing it in turn into the potassium-hydroxide and alkaline pyrogallate solutions and measuring the reduction in volume produced. The total oxygen content thus determined, minus the residual oxygen already found, represents the oxygen consumed.

Other burette readings are made in a manner similar to that in which the original volume of the sample was read. After combustion, for instance, the gas is withdrawn to the burette and the mercury in the combustion pipette brought exactly to the scratch at f. The stopcock at r is closed and the one at m opened. The solution in the capillary tube is brought to the scratch o by raising or lowering the level bulb n and the solution in the potassium-hydroxide pipette a is brought to the mark e by a slight movement of the mercury in the burette. The burette is then read.

From the contraction, the carbon dioxide produced by the combustion, and the oxygen consumed, the methane, carbon monoxide ,and hydrogen may be calculated by the following well known equations:

$$CH_4 + 2O_2 = CO_2 + 2H_2O$$
$$2H_2 + O_2 = 2H_2O$$
$$2CO + O_2 = 2CO_2$$

An analysis such as is described above can be performed in 35 minutes.

Heavy wall pure gum tubing is used on all connections, and the stopcocks are kept well lubricated. The stopcock grease used is made by adding 1 part paraffin and 3 parts vaseline to 1 part pure gum rubber. The rubber is melted, the other ingredients are added, and the mixture is then heated to melting for several minutes. The inner walls of the burette and the compensating tube are kept slightly moistened with water. The instrument should be protected from drafts and the water in the water jacket, each time before burette readings are made, is agitated by blowing air through it, thus insuring uniformity of temperature throughout the water jacket. It is desirable, if compressed air can be obtained, to keep air bubbling through the water jacket during the entire analysis. Bubbles of water or mercury must be kept out of the horizontal capillary tubing. It is scarcely necessary to add that a trace of potassium-hydroxide solution left in the tubing will ruin the value of the combustion analyses. The tubing from o over to the compensating tube i must also be kept clear of detached bubbles of the potassium-hydroxide solution.

Tabulated Results of Duplicate Analyses of a Sample of Flue Gas.

	First Analysis.				Second Analysis.			
	Volume.	Per cent.	Volume.	Per cent.	Volume.	Per cent.	Volume.	Per cent.
Observation or calculation.	1	2	3	4	5	6	7	8
	c.c.		c.c.		c.c		c.c.	
Volume of sample taken	20.178	....	20.300	....	20.379	....	20.300	....
Carbon dioxide (after caustic potash)	18.181	9.90	18,291	9.90	18,361	9.91	18,288	9.91
Oxygen (after pyrogallate solution)	......	....	16,373	9.45	......	....	16.373	9.43
Total volume of residual gas	18.181	....	......	....	18.361	....	......	....
Volume after burning	18.006	....	......	....	18.186	....	......	....
Contraction	0.175	....	....	....	0.175	....	......	....
Volume after carbon-dioxide absorption	17.800	....	......	....	17.982	....	......	....
Carbon dioxide produced	0.206	....	......	....	0.204	....	......	....
Volume after oyxgen absorption	16.022	....	......	....	17.191	....	......	....
Residual oxygen	1.778	....	......	....	1.791	....	......	....
Oxygen consumed	0.128	....	......	....	0.127	....	......	....
Methane	......	0.01	......	....	......	0.02	......	....
Carbon monoxide	......	1.02	......	....	......	0.98	......	....
Hydrogen	......	0.24	......	....	......	0.23	......	....

The following results of two duplicate analyses show the details observed and the calculations made.

In column 1 are shown data representing the changes in volume of the gas sample at different stages of the analysis.

In column 2 are shown the proportions of carbon dioxide, carbon, monoxide, hydrogen, and methane calculated to a percentage basis.

In column 3 are shown the observed data involved in the separate oxygen determination.

The final figures representing the pecentages of carbon dioxide and of oxygen are shown in column 4.

In columns 5, 6, 7 and 8 are shown the readings and results of the duplicate analysis.

From the combustion data calculations were made to show the errors that might result if the oxygen consumed were not determined, and the results were calculated to carbon monoxide and methane. The possible errors are indicated below.

Possible Errors from Failure to Determine Oxygen Consumed.

	First analysis. Per cent.	Second analysis Per cent.
Carbon monoxide	0.78	0.76
Methane	0.24	0.24

AN ELECTRIC CURFEW.

At Sacramento, Cal., the city's new electrolier system may be put to a novel use if the request of Chief of Police Johnson and Superior Judge Hughes of the Juvenile Court, is carried out. It was recommended that the street lights be alternately extinguished and illuminated at 9 o'clock each night during the summer months and at 8 o'clock during the winter months for the purpose of warning minors under the age of 16 that it is time to get off the streets and to go home.

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
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Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
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CONTENTS

The San Francisco Traffic Situation

The investigations of Bion J. Arnold, now complete, bring to light many interesting phases of the present traffic situation in San Francisco. This report, though attacked by the daily press of that city, is nevertheless a comprehensive exhibition of the true status of affairs there to be found and its citizens may well consider the scholarly conclusions and advice set forth by this noted expert.

The fact that the citizens of this metropolis have acquired the riding habit more than any other city of America must compel serious-minded men to wonder why it is that San Francisco to-day is six years behind in its traffic facilities and that traction companies claim to be unwilling to make extensions. Investigation shows that as a result of successive consolidations the original intent and conditions of many important franchises have been departed from without official consent of the city. Whether this has been brought about through lax supervision or otherwise, makes little difference; the fact remains that questionable legal status has thus ensued. Hence a number of important lines are now operating either without franchises or under questionable grants. On the other hand, the conditions of the present charter render new franchises for extensions practically prohibitive.

To add to this unfortunate situation, never before in the city's history has the necessity for smoothly-oiled franchise extension facilities been more desirable. With a world's fair not two years distant, wherein conservative estimates indicate a total transfer of 50,000 people per hour over lines that now could not possibly carry one-fourth this number, makes the problem not one of serious concern for San Francisco alone, but for the entire West, the host in this year of years.

To attempt to get to the fair grounds at the present time is to find oneself stranded on a high hill, like Moses, in full sight of the promised land, but unable to enter therein.

The problem, too, is not one of traction difficulties alone, for all other utility companies serving San Francisco are similarly hampered in extension facilities. Only recently one well-known central station found its lines but three pole distances away from a consumer who desired to sign up for a 150 h.p. load, and yet as the distance exceeded the 100 ft. limit prescribed in the charter, it found itself unable to legally extend its lines.

Considered from every viewpoint then, it behooves the people and utility companies to get together as never before with a determined, united effort to solve the question. It is heard on all sides that the great city near the Golden Gate will do it, for San Francisco knows how. Meanwhile, however, the enterprising cities about the bay are stealing many a natural birthright and if this difficulty is not solved soon, it would not be surprising to find that fully half the visitors to the great world's fair will be conducted to the grounds by ferry instead of the land route.

When a financial panic was on in the West some years back clearing house certificates, though illegal, were issued and accepted with full confidence. To-day in San Francisco, whether or not amendments can be passed in time to accomplish legal results is of but small concern. The main question is for all parties to get together on this issue, fully realizing and respecting each others rights in the matter, and with truly Western spirit put across some constructive ideas that will bring results at once.

Harmonizing Varying Frequency Networks

Riverside, California, is unique in its artificial street lighting effects which reflect, by artistically designed mission lamp posts, the glory and beauty of California's most beloved tradition—the mission architecture of pre-pioneer days. In our issue of February 15th may be found a complete déscription of this example of constructive civic life.

The Southern California Edison Company has in past years been supplementing the municipal plant of Riverside in furnishing the power for the city's supply. Under this auxiliary system, power was distributed from the city's steam plant, the Edison company's 10,000 volt and also the 33,000 volt lines. Agreeable to action just taken by the city council, the Southern Sierras Power Company will also in the future serve a portion of the city. As the prevailing frequency in Southern California is 50 cycles per second, this innovation from the Southern Sierra's line, which is 60 cycle, will be watched with much interest.

In the past the receiving of power from the three sources above detailed at Riverside has entailed considerable computation on the part of the city officials as all three sources commanded varying rates and much juggling on the part of the dispatcher was necessary to take advantage of minimum costs. Such switching back and forth requires a complicated switchboard and is often bad for the service, as the starting boxes here to be found, equipped with no voltage release, operate before the connection can be made with the other circuit.

Upon the arrival of the 60 cycle distribution, perhaps the greatest added worry will be in the meter department, where independent test boards, one for 50 and one for 60, must be maintained.

Since such splendid results are obtained in regulation and continuity of service by operating many plants in parallel, it is to be regretted that Central and Northern California are generating on 60 cycle frequency, while in Southern California it is 50 cycles for the most part. With one and the same frequency, state-wide advantage could thus be taken of joint operation and the continuity of service resulting would unquestionably strengthen the permanency of electrical consumption.

The frequency converter has during recent months made rapid strides in evolution of design and efficiency. The interlinking of all lines serving a community is not only a duty owed to the public, but for the companies concerned such a far-sighted policy has resulted in every instance, thus far attempted, in a greater consumption of electrical energy and that, too, upon a more firm, profit-making basis.

Standardizing apparatus has in former years totaled millions in additional expenditure. The railroad gauge, the air brake and a thousand other instances may easily be cited. Yet no one will gainsay the fact that in each case the resulting pliability and elasticity effected in actually producing results has fully justified this expenditure. To readjust or harmonize the varying frequencies of Western hydroelectric networks seems a Herculean task, yet it is a move fully justifying serious consideration.

Humanizing the Corporation

The people who make up the great commonalty are dis-eased. They are suffering from an epidemic of public dissatisfaction with public and quasi-public institutions. Such a disease may either be allowed to run its course until the long-suffering patient is aroused to wipe out the conditions which have brought it about or it may be prevented by speedy action on the part of those responsible. The people have already done so much to regulate these conditions that there now remains little more than the task of removing the cloud of misunderstanding which obscure the many benefits to be derived from private operation of public utilities.

This misunderstanding is mutual. The layman does not see the human element in the corporation and the corporation man is looking in a mirror when he thinks he is looking at the public.

A corporation ought to be merely a group of responsible individuals. Reduce any organization to its simplest form and you find one man who is the dynamo supplying the leading ideas and enthusiastic energy which runs it. "An institution is but the lengthened shadow of a man." The human factor is the one means of reducing the complex equation of the modern corporation, where the man is the unit of efficiency and man-powers should be the measure of capacity.

A corporation has a dual personality, the stockholders and the employees. The latter usually set the standard by which the company is judged, though, like, fire, it may be a good servant and a bad master. But, reduced to the ultimate, the employee, to the public, is the corporation. How important it is then that the will of each individual working unit be in synchronism with the rate and rhythm of the complicated whole. This can be accomplished only by recognition of the human element in the machine—humanizing the corporation.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. C. Hurlburt, representing the Proctor-Raymond Manufacturing Company of Detroit is at San Francisco.

T. E. Burger, Los Angeles, manager for the Western Electric Company, was at San Francisco during the past week.

Wm. Doherty, supply sales manager of the Northern Electric Manufacturing Company of Montreal, Canada, visited Seattle recently.

K. G Dunn, vice-president of Hunt, Mirk & Company, has returned to his San Francisco offices from a trip throughout Southern California.

C. E. Dunbar, storekeeper for the Western States Gas & Electric Company at Stockton, Cal., was at San Francisco during the past week.

V. R. Lansingh, general manager of the Holophane Works of the General Electric Company, expects to be at San Francisco during the coming week.

John Coffee Hays, president of the Mt. Whitney Power and Electric Company of Visalia, California, is expected to return from the East this week.

A. C. Balch, chairman of the executive committee of the Pacific Light & Power Corporation of Los Angeles, was at San Francisco during the past week.

H. H. Hornsby, manager of conduit and supply sales for the Sprague Electric Works, is making a trip throughout the western territory and will be in Seattle on April 29.

C. V. Schneider has been appointed Statesman for the Jovian Order at Sacramento, California, and is arranging for weekly electrical luncheons, the first to be held on April 19.

Frederick G. Simpson, general manager and chief engineer of the Kilbourne & Clarke Manufacturing Company, Seattle, has returned from a month's trip throughout the East.

Jas H. McGraw, president of the McGraw Publishing Company of New York City, has spent the past two weeks at Pasadena, California, and will return to New York by way of Vancouver.

M. G. Garhart has taken over the management of the power apparatus sales of the Western Electric Company, at Seattle. Mr. Carhart was formerly connected with the company, leaving it in 1911.

A. M. Hunt, the consulting engineer, who has figured prominently in exposition work, has been appointed as chief of the department of machinery of the Panama-Pacific exposition. He will be assisted by G. W. Danforth as assistant director.

Franklin T. Griffith, who has long served as attorney for the Portland Railway, Light & Power Company of Portland, Ore., has been selected to succeed **B. S. Josselyn**, as president of the company when Mr. Josselyn retires on July 1.

S. Evans Hodge, is representing the Westinghouse Electric & Manufacturing Company this season in Alaska, being stationed at Juneau. This is the first season the company has kept a regular representative there but expects to follow this plan each year.

J. R. Bibbins, electrical and mechanical engineer with B. J. Arnold, has completed his work on the investigation of the traction conditions at San Francisco. A complimentary luncheon was tendered him by a number of San Francisco electrical engineers on April 18th, in slight token of their high regard for his work.

OBITUARY.

Charles C. Hudson, partner in the firm of the Holabird-Reynolds Electric Company, at Los Angeles, died on Friday, April 4, 1913. His passing is a distinct loss to the trade in general and his firm in particular.

MEETING NOTICES.

Seattle Jovian League.

The Seattle Jovian League was addressed at its luncheon given on April 11 by Mr. Presby of the Holophane Glass Company, Newark, N. J., who gave a talk on Holophane glassware, how it is made and its development since first introduced.

Portland Electrical Contractors' Association.

Mr. H. W. Beckwith addressed the Portland Electrical Contractors' Association on April 9th, regarding the new Employers' Compensation Law passed by the last legislature. Mr. Beckwith is one of the commissioners who will enforce this law.

Oregon Technical Club.

The regular Tuesday luncheon was held on April 8th, at the Commercial Club. Joseph Jacoberger was chairman and Mr. R. L. Sabin of the Public School Board, speaker of the day. His subject was "Schools as Social Centers," special attention being given to methods of popularizing technical knowledge in the schools.

Portland Section A. I. E. E.

The regular meeting of the Portland Section, A. I. E. E., was held April 15th, at 8:00 p. m. in the Oregon Technical Club Rooms, 247½ Stark street. The following papers were presented. "Separation of Transformer Core Loss" by Mr. E. R. Shephard and "Methods of Calculating Speed-Time Curves and Their Application,' by Mr. Paul Lebenbaum.

Seattle Section A. I. E. E.

The April meeting of the Seattle Section was held Tuesday evening, April 15th, in the assembly hall of the Central Building, under the auspices of the Wireless Telegraph Section of the Telephone and Telegraph Group. The paper of the evening was presented by Mr. Prilip D. Naugle, entitled "The Installation and Operation of Radio-telegraph Sets."

Electrical Development and Jovian League.

This week's meeting was extremely interesting. The speaker of the day was Mr. T. Bibber of New York, who addressed the meeting on Jovianism and Co-operation and the good to come to the electrical industry in general, and especially the individual, through a closer and better understanding each with the other. Some seventy members were present and enjoyed the talk, at the conclusion of which Mr. Bibber was tendered a hearty vote of thanks.

Oregon Society Engineers.

The Oregon Society of Engineers will make a summer vacation trip to the University of Oregon at Eugene, May 17th. The occasion will be the celebration of "Commonwealth Day" and the purpose of the trip to foster higher education. All organized clubs and associations will be asked to participate. Speaking, athletics, music, refreshments, sight-seeing and inspection of university equipment will be features of the trip.

Mr. Marshall Dana, assistant editor, Oregon Journal, addressed the Society April 10th, subject, "The Press and the Professions." Good attendance and much interest prevailed. The speaker made the point that absolute confidence must exist between press correspondent and engineer or the greatest good cannot result—that with confidence existing, information becomes constructive news, without it destructive news.

Jovian Luncheon Club.

Mr. L. R. Alderman, superintendent of Public Schools, addressed the Jovian Luncheon Club at the Portland Commercial Club at luncheon on April 10th on "The New Education." In the course of his talk Mr. Alderman suggested that the Jovian Club appoint a committee to meet with his this fall and make suggestions in regard to revising the course of study to so arrange it that the course would more nearly meet the needs of the pupils, in order to equip them to be of some practical service to themselves and to their future employers. This suggestion was acted upon and the executive committee and chairman were empowered to choose a suitable committee on education. The chairman was Mr. F. D. Weber. Due to the fact that Mr. D. C. Henry has been called to Montana on business he will be unable to address the Jovian Luncheon Club next Thursday and Mr. Franklin T. Griffith, the new vice-president of the Portland Railway, Light & Power Company will address the club.

CALIFORNIA-OREGON POWER COMPANY ELECTRIC CLUB.

The Electric Club of the California-Oregon Power Company held their regular monthly meeting at Ashland, Oregon, Tuesday evening, April 11th, the meeting being in charge of C. A. Malone, chairman pro tem. About twenty-four of the employees of the company, accompanied by the famous "Zobo Band," drove from Medford in automobiles, meeting the resident employees of Ashland and others who had come in by train from other parts of the system.

A banquet was served in the Ashland Hotel, and as the subject was "The Line and Transformer," the table was decorated with a miniature pole line, showing all types of transmission pole line in use on the system. This pole line ended in a "power house," near which the most distinguished guests were seated, and which proved to be "loaded." Later in the evening a large bunch of firecrackers exploded inside the "power house" to the consternation of those seated nearest it at the table. During "roll call" each member was called to his feet by the toastmaster's version of what his initials stood for, and his "electrical characteristics."

Sidney Sprout gave an interesting description of the "History and Evolution" of various types of construction on the 475 miles of transmission line now operated by the company.

J. D. Sinnott talked on "Slide Ruling the Line Loss" and showed numerous short cuts with the slide rule in figuring line loss.

O. B. Helt spoke of "High Tension Line Protetction Devices," illustrating his remarks with stereopticon slides.

C. G. Ware described "Live Losses in Central Point and Gold Hill," casting some interesting and humorous reflection on the local conditions at these points.

H. C. Stoddard described "Methods of Line Construction," illustrating his remarks with a number of stereopticon slides showing various types of line construction in both the United States and foreign countries, as well as numerous pictures of construction types on the lines of the California-Oregon Power Company.

H. L. Walther spoke on the "State Commission's Attitude Toward Line Construction," giving the results of the work of the Oregon Commission up to date.

J. J. Buchter discussed the "Ashland Line to the Elk's Dance," giving an interesting and amusing account of his experiences as cashier of the company.

T. G. Bradley spoke on "The Line From the Operating Engineer's Point of View," showing how the work of the construction force affected and sometimes caused trouble for the operating department.

F. F. Loder gave a short talk on "The Lineman's Protection," describing various protective and grounding devices, also the grounding of secondary lines.

W. H. Searle, the club artist, displayed on the screen, cartoons of most of the members present, which showed very clever work.

C. R. Wallis of the General Electric Company spoke on "Transformers," describing transformer types in general, as well as those manufactured by his company, illustrating his remarks with slides.

O. G. Steele described "Methods of Installing Outdoor High Tension Transformers," giving some very interesting data from the results of his experiences in this type of construction.

R. R. Ebel talked on "Charging a Line to Parallel With Estimate," showing the accounting necessary from the point of view of the Auditing Department to properly charge out the material and labor on a construction job.

G. B. Conwell gave a description of various types of transformer connections, illustrated by colored stereopticon slides showing in a very ingenious system of diagrams the different connections.

Music for the evening was furnished by D. L. Colvig, pianist, assisted by Mr. Ebel and his "Zobo Band." The next meeting of the club is to be at Medford, Wednesday, May 14th, under the leadership of H. O. Purucker, Chairman pro tem.

TRADE NOTES.

The J. C. English Company of Portland, Oregon is building a new shop on the corner of E. Irving and Union avenue.

The Allis-Chalmers Company have just signed a contract with the Pacific Fixture and Cabinet Company, Portland, Oregon, for 15 electric motors ranging from 2 h.p. to 25 h.p. The motors being 3-phase, 60 cycle, 220 volt.

The Alaska Light & Power Company, Juneau, Alaska, E. J. Margrie, general manager, recently placed an order with the Westinghouse Electric & Manufacturing Company for two 625 k.v.a. water wheel type generators, 3-phase, 60 cycle, 2400 volts.

The A. G. Electric & Manufacturing Company, Seattle, have made such improvements in its "Diamond (A. G.)" switches as to enable it to go into more active competition in the switch market of the northwest. It will also increase the scope of the business by an active campaign for making specialties, particularly patented articles of any kind. The office at Portland is being enlarged. Priest & Peterson have charge at that point.

The Westinghouse Electric & Manufacturing Company has secured an order from the city of Seattle for 12 double equipments of 310 C. commutating pole motors complete with type H.L. unit switch control. These motors are rated 60 h.p. at 500 volts and 75 h.p. at 600 volts. The municipal railway system to be installed will be operated with two trolley wires and will therefore be an ungrounded metalic return circuit. Cars will be provided with double end control which calls for two trolleys at each end of the car. The trolley wires will be spaced 18 inches apart and symmetrical with the central line of the track. Operation is contemplated over the lines of the Seattle, Renton & Southern Railway system which uses the ordinary single trolley grounded return circuit. The two trolley bases at each end will be mounted on movable mechanism for side shifting by means of compressed air controlled from the motorman's cab. The car bodies are being furnished by the Cincinnati Car Company; the trucks by the Standard Motor Truck Company of Pittsburgh and the brakes by the Allis-Chalmers Company.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

RECOMMENDATIONS FOR ELECTRICAL INSTALLATIONS IN WOOD WORKING PLANTS, MANUFACTURING PLANTS, WAREHOUSES, PACKING HOUSES, CANNERIES, MINING PLANTS, ETC.

COMPILED BY F. D. WEBER.[1]

(Continued.)

[N. B.—Owing to a mistake in the arrangement of the second installment of this article, the matter published in the issue of April 12th should be disregarded and the following regarded as a continuation from April 5th.]

Oil Transformers.

6a. Must not be placed inside of any buildings except central stations and substations, unless by special permission of the inspection department having jurisdiction. (Rule 36a.)

When permitted inside buildings under Rule 14, N. E. C., must be located as near as possible to the point at which the primary wires enter building. (Rule 45a.)

Must be placed in an enclosure constructed of fire-resisting material; enclosures to be used only for this purpose, to be securely locked, and access only allowed to responsible parties. (Rule 45b.)

Must be thoroughly insulated from the ground or permanently and effectually grounded, and the enclosure in which they are placed must be practically air-tight, except that it may be thoroughly ventilated to the outdoor air, if possible through a chimney or flue; there should be at least 6 in. air space on all sides of the transformer. (Rule 45c.)

In order to obtain the approval required of the inspection department, as stated above, transformers must be safeguarded by resting on concrete of at least three (3) in. in depth; be placed immediately under the sidewalk, if possible, in an enclosure which must be ventilated by an opening at least six (6) in. square through the sidewalk or to chimney or flue; the fire-resisting material used in constructing the enclosure in which the transformer is located, and by which it is effectually cut off from the remaining part of the basement, must consist of a brick or concrete wall at least eight (8) in. in thickness, and have no communication into rest of building unless access is obtained through an approved fire door. The transformer room so constructed must be supplied with sill, to prevent the flow of oil into the basement in case of explosion.

As an alternative to the above construction, the transformer may be placed in a tight steel tank, ventilated to the street, and standing on concrete.

Air-Cooled Transformers.

6b. "Must not be placed inside of any building, excepting central stations and substations, if the highest voltage of either primary or secondary exceeds 550 volts." (Rule 36b.)

"Must be so mounted that the case shall be at a distance of at least one foot from combustible material, or separated therefrom by non-combustible, non-absorptive, insulating material, such as slate, marble or soapstone. This will require the use of a slab or panel somewhat larger than the transformer." (Rule 36c.)

Note: The above sections do not apply to apparatus or fittings, the operation of which depends either wholly or in part upon special transformers embodied in the devices, but all such apparatus or fittings must be submitted for special examination for approval before being used.

7. Service wires (overhead) must be dead ended, have drip loops outside and must enter the building through porcelain tubes slanting downward to the outside, or enter the building through approved metal conduit, the outer end to be equipped with an approved service head and the inner end must be equipped with a condulet or outlet box, and the inner end must extend to the service cutout, and if a cabinet is required by the National Electrical Code or this pamphlet, must properly enter this cabinet. (Rule 12f.) If the wires are to enter the building underground, approved conduit must be used and extend in a continuous length from the outside into the main switch and cutout cabinet. The outer end of the conduit must be equipped with an approved service head. The main switch and cutout cabinet must meet the requirements hereinafter specified in Section 22 of this pamphlet for cabinets for conduit work. (Rule 28b.)

7a. Service Feeders and Sub-Feeders for Lighting Systems and Heating Systems. Sufficient capacity must be installed in all cases so as to furnish 3 amperes per circuit for 3-wire service and 6 amperes for circuit for a 2-wire service. Any deviations from this must be sanctioned by the inspection department in writing.

7b. Service Feeders and Sub-Feeders for Power. Same must be installed according to publication on d.c. and a.c. motors. When power installations are of an extensive character with a great number of motors, the "load factor" will be considered and same should be taken up with the inspection department.

8. Automatic Cutouts. (Fuses and Circuit Breakers).

"Must be placed on all service wires, either overhead or underground, in the nearest accessible place to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building." (Rule 23.)

9. Switches must be placed on all service wires, either overhead or underground, in the nearest readily accessible place to the point where the wires enter the building and arranged to cut off the entire current.

Service cutout and switch must be arranged to cut off current from all devices, including meters. (Rule 24.)

Branch Circuit Wiring—Light Wiring.

The following is applicable whether current is supplied from a generator at the plant or from an outside source:

10. Branch Circuit Cutouts must be of approved design (Rule 67, Sections a to d) and provided with enclosed fuses. Cutouts should be assembled and placed in dust or moisture proof cabinets, as the case may require, so located as to be readily accessible. (Rule 19, Sections b to c).

11. Branch Circuits. A separate branch circuit must be provided for each 660 watts, i. e., the equivalent of 11 or 12 16 c.p. lamps, carbon filament. (Rule 23d.) It is advisable not to load each circuit to its full capacity in order that additional lights may be added in the future if it should become necessary. Also see Section 7 of this pamphlet.

12. Joints must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered to insure preservation and covered with an insulation equal to that of the conductors. This will require all joints made in rubber-covered wire, wrapped with both rubber and friction tapes. (Rule 16c.)

13. Drop Cords must be stranded rubber-covered wire not smaller than No. 14 B. & S. gauge, or what is known as stranded brewery cord or packing house portable cord may be used. Cords must never be longer than is necessary for efficient lighting. Never use the ordinary pendant cord.

14. Sockets. In damp or wet places weather-proof sockets must be used. They must be hung by separate stranded rubber-covered wires not smaller than No. 14 B. & S. gauge, which should preferably be twisted together when the pen-

[1]Electrical Inspector for Underwriters' Equitable Rating Bureau, Portland, Oregon.

dant is over three feet long. These wires must be soldered direct to the circuit wires but supported independently of them by knobs. (Rule 31b.)

In dry places stranded brewery cord or packing house portable cord and keyless brass sockets may be used.

The lamp globe in all cases must be protected by an approved wire guard.

In rooms where inflammable gases may exist the incandescent lamp and socket must be enclosed in a vapor-tight globe. (Rule 31a.)

Rosettes should never be used.

Key sockets must not be used. (Rule 31c.)

15. Control Switches for Drop Lights. Drop lights should be controlled by switches, placed in the branch cabinets, or wall switches conveniently located. Snap switches must not be used unless enclosed in dust or moisture-proof cabinets. Knife switches, if exposed to dust, must be placed in cabinets, and if exposed to moisture must be placed in a moisture-proof cabinet or be mounted on porcelain knobs. (Rule 19c.)

16. Portable Lamps. Where long drop cords or portable lamps are necessary the cord must be of the reinforced portable type (preferably what is known as packing house portable cord), and the lamp must be provided with a good substantial guard. (Rule 32d and 54, Section c, Division 2.) The best practice is to use a detachable portable extension made of the portable cord specified above, with an attachment plug and a lamp provided with a good substantial guard with wooden handle and hoop on tip.

When lights must be suspended over the work, in lumber mills, planing mills, etc., make an inverted trough of 1 in. lumber, painted white on inside, and support the wire on the inside of the trough. Wooden moulding will not be approved for use with this trough. The connection between the trough and the rest of the system should be made with a stranded rubber-covered wire, properly dead-ended.

17. Arc Lamps. Each lamp must be protected by an approved double pole cutout and each arc should be preferably on a separate circuit. Must be supplied with globes and protected by spark arrester and have wire netting around the globe, the mesh not exceeding 1½ in. (Rule 33a to d.)

For Open Knob and Cleat Work.

18. Cabinets must be substantially constructed. If of wood use well-seasoned lumber. The door must hinge from the top in order that it may be self-closing, close against a rabbet and be provided with a substantial catch. The bottom must have a slope of 45 degrees to prevent the accumulation of any foreign material. The cabinet must be well painted with moisture-proof paint and then lined with asbestos board at least one-eighth inch thick, same to be securely tacked in place and the whole to be well painted. The door must be lined the same as the cabinet. (Rule 70.)

Iron cabinets only will be sanctioned with metal conduit, and are recommended for use with knob and tube work, as they are more durable and generally better constructed. (Rule 70.) These must also have doors hinged at top and have the door overlap sides and bottom of cabinet, making the hinged part of the door also dust tight. The bottom must have a slope of 45 degrees to prevent the accumulation of any foreign material.

19. Insulating Supports and Bushings. Wires must be supported at least 4½ ft. by single wire cleats or knobs. (Never use two-wire cleats, as dust or moisture is liable to collect between the two parts and may cause a short circuit.) Wires passing through walls, timbers or floors should be kept from contact with woodwork by porcelain insulating tubes, which must be long enough to bush the entire length of the hole in one continuous piece. (Rule 16, Sections d and e.) Bushings through floors should extend at least one inch above the floor in order to prevent dust and sweepings from collecting in the tubes. The tubes should be protected from mechanical injury by a suitable protecting box of wood or approved metal conduit.

20. Protection to Wires. Where wires run on low ceilings, on walls or partitions or supporting posts, or close to belts, pulleys, etc., they must be protected from mechanical injury. (Rule 20e.) Adequate protection on low ceilings is secured by wooden guard strips placed on each side of and one inch from the wires. These strips should be at least one inch thick and two inches high. Wires must never be run from timber to timber. A good substantial running board, preferably a 2 x 6, in., must be put up and the wires knobbed to the under side, and then guard strips put up in addition if the wires are exposed to mechanical injury. And if wires are exposed to excessive moisture, guard strips and running boards should be put up forming an inverted trough to protect the wires from the same.

Suitable protection on walls, partitions and vertical timbers may be obtained by substantial boxing enclosing the wires, same to extend not less than seven feet from the floor. Boxing should be closed at the top to keep out dust, etc., the wires passing through bushed holes. Wires must have at least an inch separation from the inside of the boxing.

Instead of guard strips or boxing, wires may be run in approved metal conduit installed according to (Rules 27 and 28, N. E. C.)

Wires must be rubber-covered, unless run in open dry places, and then slow-burning wire may be used. (Rule 28, Sections g and i.)

For Conduit Work.

22. Cabinets must be constructed of steel or iron and be of approved make. (See Division 18 of this pamphlet.)

23. Conduit must be well supported with pipe straps. All elbows or bends must be made so that the enameling or coating will not be injured. Ends must be well reamed. Where entering cabinets or outlet boxes must be provided with a lock nut and bushing. The lock nut must be screwed up tight in order to make a good electrical connection as well as mechanical. Where wires leave the end of the conduit the conduit must always be provided with a condulet or outlet box, the wires passing out through separate holes bushed with porcelain. Drop cords may pass through a bushed hole in the top of the outlet box and then knotted on the inside. All lengths of conduit must be permanently and effectively grounded. The ground wire must make good electrical connection with the conduit. (Rules 27c and 28f.)

24. Wires used with metal conduit must be double braid rubber covered. (Rule 56.)

(To be continued.)

NEWS OF THE ELECTRICAL CONTRACTORS.

Buxbaum & Cooley, electrical contractors, 68 Columbia street, Seattle, are installing an electric light plant on the steamer Neptune.

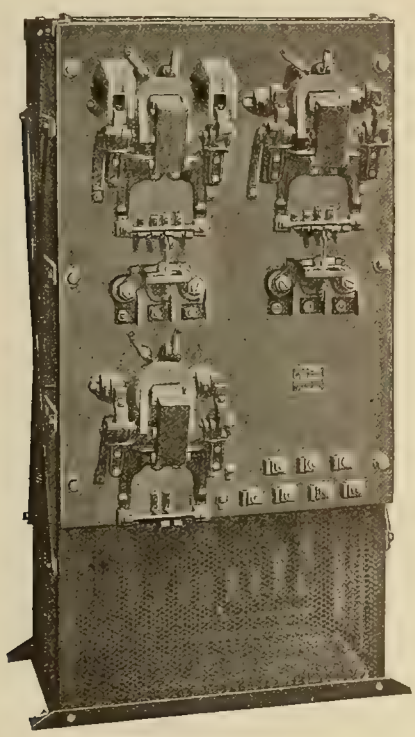
The Columbia Electric Company, 1019 Post street, Seattle, is re-wiring the Provident building, installing a new conduit system throughout at a cost of about $3000 and also has the job of wiring the new summer home of D. E. Frederick at Hylands.

The Lushington Electric Company, 1314 First avenue, Seattle, has finished wiring the clothing store building of Shafer Brothers, corner Second avenue and University street. Frink reflectors were installed in front. A contract has just been closed by the company with Guy Wing for installing a new lighting system in his cafeteria at 1407 First avenue. The cafeteria is to be remodeled throughout and an adjoining store room added. Acmelite reflectors made by Gill Brothers of Steubenville, Ohio, are to be used. At Everett, Washington, the company recently installed complete lighting fixtures in the Rannie Dancing Academy. Changing the lighting fixtures in the city hall from direct to indirect, using ex-ray reflectors known as the Eye Comfort, is one of the local jobs.

INDUSTRIAL

NEW SELF-STARTERS FOR POLYPHASE MOTORS.

One of the new self-starters for polyphase slip ring motors made by The Cutler-Hammer Manufacturing Company of Milwaukee, is shown in the illustration below. Two classes of these panels are made. One is designed for use with motors driving reciprocating pumps, air compressors and similar machines that must be started under full load and which require a starting torque equal to or in excess of the normal full load torque of the motor. The other class (Bulletin 9640) is designed for use with motors driving centrifugal pumps or other machines having similar load characteristics. These self-starters are of the multiple solenoid type, entirely self-contained, made in standard capacities up to 200 h.p. Where used in connection with motors operating on compression or open tank system, the motors can be started and stopped automatically by means of pressure regulators or float switches.



Cutler-Hammer Self-Starter Panel for Polyphase Motors.

The acceleration of the motor is controlled by resistance in each of the three phases of the rotor circuit which is cut out of circuit step by step by two-pole solenoid switches under the control of the secondary current relays. The resistance is balanced on all steps. The rate of acceleration is controlled by three-phase current relays in the rotor circuit, each arranged so as to prevent the following step of resistance from being cut out of circuit until the secondary current has dropped to a safe value and the motor has accelerated properly, when it will permit the next step of resistance to be cut out. The starting current is limited to a predetermined (and adjustable) value by the current relays and the motor is accelerated in the shortest time consistent with this starting current.

The primary switch and starting switches are of open construction clapper type. The heavy drop-forged copper contacts are easily renewable. The primary switch contacts are protected by powerful blowouts and the entire switch is constructed so as to reduce to a minimum the wear incident to frequent opening and closing. The current relays have three coils connected in the secondary circuit with the starting resistance and carrying the starting current. The relay plungers are thus controlled directly by the starting current and the rate at which the motor is accelerated can be adjusted by varying the spring tension on the relay plungers. The secondary starting resistance is of the cast metal grid type having ample capacity for starting the motor intermittently under load conditions.

WHAT THE WESTERN ELECTRIC COMPANY IS DOING TOWARD THE RESTORATION OF ELECTRIC SERVICE IN THE MISSISSIPPI VALLEY.

The test of an organization comes in an emergency such as recently arose in the Mississippi Valley. The first unusual demands for special service came to the Western Electric Company from tornado-stricken Omaha where the telegraph and telephone lines were seriously interfered with. The company was notified that 8000 poles, 25,000 cross-arms, 100,000 pins and 32,000 ft. of telephone cables ranging in size from 25 pair to 400 pair, were immediately needed. The southern demand found the organization keyed up for a quick response and on the day the order was placed, 20 carloads of poles, 100,000 pounds of copper wire and all of the above cable went forward. The company's stock of 25,000 cross-arms at Minnesota transfer was drawn upon, the poles went forward from the yards in Michigan and the balance of the equipment from the Chicago stock.

The next call was for cable for the Chicago district, for the Western Union Company. This emergency cable, to the extent of 235,000 pounds, went forward at once by express from New York, almost every through passenger train leaving the East for Chicago up to the time traffic was suspended being pressed into service to carry its quota of this cable.

In the meantime, the floods began to make themselves felt in Indiana and Ohio where, within a few days, not only telegraph and telephone service, but electric light, street railway and railroad service was completely demoralized. Again came the call for emergency line material. First of all, the company's stocks of cable, cross-arms, wire and line construction material of every description located in its distributing houses at Cleveland, Pittsburgh, Indianapolis and Cincinnati, were drawn upon; and then the outlying houses were notified to be ready with their assistance when it was needed. Complete stocks were available at Boston, New York, Philadelphia, Richmond, Atlanta, Kansas City, St. Louis, Minneapolis and Dallas—these houses, constituting a chain of reserve depots surrounding the stricken district, while further west were the other distributing centers of the company which might also be called upon to help.

Meanwhile, it was seen at the company's executive headquarters in New York that with all these reserve stocks depleted, they must be immediately replenished. Accordingly, telegraphic orders were issued to send East from Washington, 50,000 cross-arms, and requisitions were placed upon the company's sources of supply to increase the stock of copper wire available for shipment to upwards of over a half million pounds and for the drawing of several hundred thousands pounds of copper wire and the furnishing of from five to ten million feet of rubber covered wire and outside distributing wire.

So much for the measures taken to remedy outside plant conditions. Following the subsiding of the waters it was expected that there would be like demands upon the company for reserve telephone exchange equipment. At this

writing, the first of these calls had only just begun to come, but the company was ready with men and apparatus to meet this phase of the emergency. The first call on the New York office was on the morning of March 31st, when word came to move a force of telephone installers and switchboard material with the greatest possible speed to Marietta, Ohio, where the lower floors of the Bell telephone exchange building had been flooded to the ceiling, the terminal and power equipment completely submerged and telephone service entirely suspended. Before the day was over, tools and material were in transit on taxicabs to the afternoon Baltimore & Ohio express for Wheeling. With this material went a number of men with the superintendent of installation. Their numbers were augmented by others from Philadelphia, Pittsburgh and other Pennsylvania points, and on noon of April 1st the entire party in motor boats, which had been chartered for the occasion, started down the Ohio River for Marietta, this being the only means of approaching the stricken district.

When the demands for material from the flood centers began to arrive, all sorts of expedients had to be resorted to to get the material where it was wanted. One entire carload of emergency line material, which the Western Electric Company endeavored to ship by express to Cincinnati, neither the express companies nor the railroads would undertake to deliver, and the car was routed from Chicago to Nashville in the hope of approaching Cincinnati from the south. Unfortunately, however, just as the car was about to arrive in Cincinnati, the flood in the Ohio River reached that point, and several days delay ensued. Not until April 2 did the transportation companies accept express shipments for Ohio and Indiana points, but, anticipating this delay, the Western Electric Company forwarded from Chicago to Toledo several carloads of material intended for Columbus, Dayton, Zanesville and Springfield. They were billed to Toledo in the expectation that when traffic was opened up they might be moved forward with less delay. This expedient proved a wise one, as these cars were among the very first to get through to the districts that had been submerged. Dayton alone ordered 5000 telephone subscriber sets, besides enormous quantities of wire for both inside and outside use. The subscriber sets were used to replace those which had been water-soaked. Along with them went 40 private branch exchange switchboards for use in business offices in and around Dayton.

In the cable plant of the Western Electric Company at Hawthorne there was ready for delivery several carloads of cable to be shipped to distant points in the United States. As the need arose, permission was secured from the telephone companies by whom this had been ordered to divert it to the emergency use where it was required. This stock formed a valuable addition to the regular emergency stocks carried at the factory, and within the space of a few days, over 500,000 ft. of cable in sizes ranging from 25 to 400 pair were shipped out from Hawthorne; 300,000 pounds of this went by express, and upon it the express charges aggregated over $6000. This was, of course, only the first call for construction material and represented as much as could be handled by the construction gangs in the first few days after the water had subsided. The factory was at once placed on a night and day basis and later orders are being filled in the order in which they are received.

District Manager F. A. Ketcham of the Western Electric Company's Chicago office, in speaking of the situation on April 4, said: "I estimate that before the entire damage is repaired we will ship out approximately 1,000,000 pounds of copper line wire. 7,000 000 or 8,000,000 ft. of No. 17 drop wire, 40,000 to 50,000 cross-arms together with the associate hardware, and probably 400,000 lbs. of No. 12 iron wire. I understand that the American Telegraph & Telephone Company estimate that they have lost about 4000 poles and the Western Union Company about 8000. We have been shipping from our various yards from 20 to 30 carloads of poles a day, this representing not the limit of our resources but rather the transportation facilities available. The loss to the telephone companies in Ohio and Indiana will be less than was originally estimated in so far as central office equipment is concerned. Most of the large switchboards in the flooded districts were, fortunately, located above the ground floors of the buildings and the loss to this equipment will be relatively small."

HELPING THE "MOVIES" TO TALK.

The telephone is now used to help the "movies" to talk. Thomas A. Edison's latest invention, the Kinetophone, is a combination of film and phonograph, whose record should be absolutely synchronized. When the actor's lips form a word, that word must be reproduced by the phonograph at that instant, otherwise the effectiveness of the combination is entirely destroyed. This would naturally not be a very difficult matter if the reel and phonograph could be placed next to each other on the stage but as the moving picture is invariably placed back of the audience in what is known as the "reel house," this is not possible. On the other hand, the phonograph must be placed on the stage so that the sound will be directed toward the audience.

After a number of methods were tried out it was found that by making use of an intercommunicating telephone system the best results were obtained. At all moving picture and vaudeville houses where the talking pictures are shown, the two attendants—the one operating the reels and the one operating the phonograph—are connected by means of a special three-wire private line circuit. At each end of the line a Western Electric No. 1001-E Interphone hand set affords a means of constant and instant communication between the two men and in this way enables the operator of the picture machine to synchronize the pictures with the phonographic record. This type of hand set was chosen inasmuch as it is especially adapted for this class of service on account of its being practically indestructible. In addition to the hand sets, a push button and buzzer are installed at each station, for signaling.

As a further aid to the moving picture operators, the Edison Company is furnishing them with Western Electric No. 153-W double-head receivers, which act as an auxiliary for the hand set. This makes it possible for the machine man to attend to his work and still be in constant communication with the phonograph man and able to hear what he has to say at all times.

NEW CATALOGUES.

The A. G. Electric & Manufacturing Company, Seattle, has issued new discount sheets for its entire catalogue, reducing the price on practically everything.

American Electric Company of Chicago, have issued a neat booklet entitled "The Remarkable Growth of An Idea," which shows the adaptation of the Burns adjustable telephone bracket to many articles in daily use.

Western Wood Preserving Company, 3619 South Main street, Los Angeles, are distributing an interesting bulletin on "Anthralin" pole and cross-arm stains, an ingenious combination of penetrative timber-preservation with a durable decorative coating.

Hemingray Glass Company of Covington, Ky., have published a booklet of "Some Interesting Facts About Hemingray Glass Insulators." These include not only the facts of annealing to avoid strains, but also the detailed results of a large number of tests in the electrical laboratories of the Worcester Polytechnic Institute.

NEWS NOTES

ILLUMINATION.

EPHRATA, WASH.—It is reported that a lighting plant to cost $10,000 will be installed this spring.

SAN BERNARDINO, CAL.—The Mayor of San Bernardino is in favor of acquiring a municipal lighting system.

REDMOND, ORE.—City lighting committee plan installation of cluster lights in business section and other lights in residence section.

OAKDALE, CAL.—J. R. Anderson has been granted a certificate of public convenience and necessity for the operation of a gas plant under a franchise from the city.

MONTESANO, WASH.—The Northwest Electric & Water Works will use the proceeds of a recent bond sale to complete work planned at the electric and water works at Sylvia Lake.

LOS ANGELES, CAL.—Permission has been granted by the city council to property owners along Olive street, between Pico and Sixth streets, to install an ornamental lighting system.

ARLINGTON, ORE.—An election will be held here on April 21 to vote on issuing bonds in the sum of $15,000 for the installation of a lighting plant and improvements to the water system.

ELMA, WASH.—The Elma Light & Power Company has been granted a new franchise. The old one was acceptable to the light company, but its bonds could not be sold under its conditions.

OREGON CITY, ORE.—A. L. Beatie, his heirs, successors and assigns have been granted for a period of 25 years, the right and privilege to erect and operate an illuminating gas plant in this city.

MADERA, CAL.—The Railroad Commission has rendered a decision granting the application of George W. Kitchen for a certificate of public convenience and necessity for the construction of a gas plant in this city.

MARYSVILLE, CAL.—The Oro Electric Corporation has applied for a franchise to erect and operate lines for transmitting electricity along certain streets in the city. Sealed bids will be received up to May 19th for the sale of the franchise.

VALLEJO, CAL.—The plans and specifications for the electroliers system on Georgia street which was recommended by the committee from the Merchants' Association were approved and adopted at a meeting of the city council. Bids will be advertised for at once.

TROPICO, CAL.—The Pacific Light & Power Company has been granted permission to construct and maintain for a period of 40 years, an electric pole and wire system upon alll streets, alleys and thoroughfares in the city of Tropico, for the purpose of transmitting electrical energy and electricity for lighting, heating and power purposes.

RIVERSIDE, CAL.—Important extension of the city's electric lighting system were provided for at a meeting of the board of public utilities. Plans for a new substation at Arlington to handle power delivered to the city by the Southern Sierra Power Company, were submitted and numerous extensions of the light system were granted. These include ornamental lights for Market street, between Seventh and Whittier place, and also installation of ornamental light system for Brentwood place.

HELENA, MONT.—The special committee appointed by the city council of Helena, Montana, to look into the question of light and power charges, has reported that in its judgment the rate for light and power is too high in the city and also subscribed to the view that rates are too high throughout the state where current is generated by the use of water power. The committee recommended that a meeting be held at Helena on April 28 by representatives of various interested cities. The Helena council adopted the report of its committee and authorized the issuance of a call for the meeting. It is expected that the result of the meeting will be an application to the public service commission of the state for a reduction of rates.

TRANSMISSION.

RANDSBURG, CAL.—At a meeting of the directors of Placer Gold Company held at Los Angeles, an assessment of two cents a share was levied upon the capital stock of the company to raise sufficient funds to equip the plant two miles south of Randsburg, with electric power.

SPOKANE, WASH.—Sealed bids will be received up to May 15 at the office of L. L Work, president of the Similkameen Power Company, for the purchase of the hydroelectric plant and other property of the company, on the Similkameen River, about four miles from Oroville. The property consists of water appropriations, power plant buildings, machinery, concrete work, water ways and tunnel, transmission lines, transformers, tools, fixtures, wire and supplies.

CENTRALIA, WASH.—Rumors are in circulation that another big water power project is to be launched in the Cowlitz valley near Mossyrock, 33 miles from Chehalis. It is announced that H. T. Wilkerson of Portland, vice-president of the Hillsboro Townsite Company, a Portland concern, has secured option on seven acres of land on the Cowlitz River for water power purposes. The option provides that work shall begin on development within sixty days.

TRANSPORTATION.

ORANGE, CAL.—The supervisors have sold to the Pacific Electric Railway a franchise to construct a railroad from Alamitos to Bay City.

VANCOUVER, WASH.—Dr. Isabel Sedgwick-Putnam of this city, representing unknown capital, has applied for a franchise for electric railway line in this city. Arthur Languth of Portland, attorney, will represent Dr. Putnam.

SAN RAFAEL, CAL.—The Fairfax Development Company, the owners of 160 acres of land to the west of Fairfax Park, has let a contract to erect an electric incline railroad to run from the front of its holdings 800 ft to the west of Fairfax station to an elevation of 500 ft.

TACOMA, WASH.—The city council of Tacoma has under consideration the question of a proposal to the Tacoma Light & Power Company for an electric street railway line to operate over the Eleventh street bridge and across the tide flats. This is the route proposed to be traversed by the contemplated municipal system and the company is taking this step on the theory that a municipal street railway is something not to be encouraged except as a final recourse. The bond election on the proposed municipal line will be held May 10.

FALLON, NEV.—At a meeting of the Fallon Belt Railroad Dr. C. A. Hascall was elected general manager and Attorney E. E. Winters, secretary. Following is the board of directors: A. R. Merritt, C. L. Weaver, Fred Wightman, C. E. Kent, W. H. Williams, Scott Harmon, A. Bauman. A. R. Merritt was elected president; Scott Harmon treasurer and E. E. Winters, secretary. The organization is known as the Fallon Electric Belt Line, with a capitalization of $300,000. Dr. Hascall, the manager, announces that they expect to build the line to Stillwater and to the Beckstead store in time to move the beet crop the coming fall.

SAN FRANCISCO, CAL.—As a means of increasing the street car facilities to the Exposition site and the northern section of the city, the North Central Improvement Association will urge the supervisors and United Railroads to arrange for the use of lower California street, from Kearny street to Market street, and the ferries as a direct route from the foot of Market street to the fair grounds. The United Railroads has a franchise on lower California street formerly used by a horse car line, but since the fire it has not been operated. The association will advocate the use of this franchise as a connection with the Kearny and Columbus avenue route to the fair via North Point street, with a terminus directly at the easterly entrance to the Exposition.

TELEPHONE AND TELEGRAPH.

ALERT BAY, B. C.—The provincial government will build 120 miles of telephone line from Campbell River to this place.

EDMONTON, ALTA.—The Northern Electric & Manufacturing Company has received a contract for 257,500 ft. of steel wire for the municipal telephone department.

BAKER, ORE.—The county court granted the petition of John Trimble to construct a telephone line from the city limits on the county road to the Baker Salisbury road.

HELENA, MONT.—The Mountain States Telephone Company, E. M. Burgess, Denver, vice-president and general manager, plan improvements to the system here to cost $140,000.

SUMAS, WASH.—The Farmers' Mutual Telephone Company has purchased property on Garfield street and will erect a brick or concrete one story building. A new and complete system will be installed.

ALTURAS, CAL.—W. J. Bradley has made application to the board of supervisors for a franchise for a telephone and telegraph line for the county of Modoc. Sealed bids will be received up to April 8th, for the sale of said franchise.

BAKER CITY, ORE.—John Trimble has been granted permission to construct a telephone line from the city limits of Baker out the county road to the Baker-Salisbury road, thence to Stice's Gulch, Hereford and intermediate points.

HELIX, ORE.—The Jupiter Telephone Company has been organized. Peter Suhl is president; J. S. Norvell, vice-president; Fred Morrison, secretary-treasurer. A line is to be built to the Wm. Dorran place, and will be a Metallac system.

RIALTO, CAL.—The Union Home Telephone & Telegraph Company has been granted a franchise to construct and maintain wires, poles and other appliances, for the transmission of electricity for telephone and telegraph purposes, in and along certain streets in Rialto.

HAYDEN, ARIZ.—F. E. Webster, superintendent of telephones for the Ray Consolidated Company, was in Superior recently looking over plans for the erection of a telephone system for the Calumet & Arizona Mining Company between its mines at Superior and connecting with the Ray Consolidated Copper Company's system at Ray.

SAN DIEGO, CAL.—C. L. Lewis, Los Angeles, superintendent of the third district of the Pacific division of the Postal Telegraph Company, announces that the company will build an entirely new pole line to San Diego, the improvement to cost $100,000. The line will be of modern construction, the wires to be of copper, and so arranged that telephone service may be installed with little trouble.

SAN FRANCISCO, CAL.—The Supreme Court reviewed the petition of the Pacific States Telephone & Telegraph Company against the railroad commission to compel that company to make physical connection for long distance business with the two small independent corporations, the Glenn County Telephone Company and the Tehama County Telephone Company. A brief will be filed by the company before April 23, and the commission will file an answer by May 1.

SACRAMENTO, CAL.—E. M. Wilder, commissioner of public works, is preparing an ordinance fixing the rates to be charged by the Pacific Telephone & Telegraph Company, one of the public service corporations affected by the provision in the charter that the city commission fix rates and quality of service. As a result of the public hearings and several conferences with the State Railroad Commission, the proposed ordinance will prohibit the requiring of a deposit of $5 when telephones are installed, and the penalty of 25c charged when a bill is not paid before the tenth day of each month.

WATERWORKS.

PORTLAND, ORE.—Bids will be received in the near future by the city water board for lowering the submerged 24 and 28 in. water mains across the Willamette River. The estimated cost is placed at $65,000 by Engineer Clarke.

FULLERTON, CAL.—The Fullerton domestic water plant, a private corporation now furnishing the water service to the citizens of Fullerton, will be taken over by the city on May 1. The price agreed upon after long negotiations was $12,500.

TACOMA, WASH.—The council has passed an ordinance providing for the construction of sanitary works for the purification of the waters of Green River above the headworks of the city gravity water system, and to appropriate $15,000 for the purpose.

VENTURA, CAL.—The supervisors have granted a franchise to Ojai Power Company for a water system in Ojai valley. The company has already purchased the several systems now in use in the valley, and with granting of franchises, is planning to rebuild the complete system.

PENDLETON, ORE.—The $200,000 bond issue voted a year ago has been ordered sold by the council. Work has been under way for a year on a gravity water system, and the city is now ready to install a pipe line to connect with the reservoir. Water will be brought 16 miles from springs in the foothills.

OXNARD, CAL.—No bid was received by the city for the issue of $10,000 bonds for construction of a municipal water system. The bonds are all of $500 denomination, bearing interest at 5 per cent, interest payable semi-annually. The board may advertise for bids for the construction of the system and offer the bonds in payment of same.

LOS ANGELES, CAL.—Active preparations for installing water mains throughout Factory Center tract of the Pacific Realty Bonds Company, at North Wilmington, are under way. The work will be in charge of G. W. Hawkins, president of the company. It is the intention of the company to pipe the entire tract with high pressure water mains, connecting every lot in the 20-acre subdivision.

OAKLAND, CAL.—Answering in detail the lengthy list of questions propounded by J. H. Dockweiler, municipal water expert, a report of the real estate holdings of the People's Water Company was submitted to the Oakland City Council by George H. Wilhelm, chief engineer of the company. The report will be utilized in fixing the water rates for the fiscal year 1912-1913. Consideration of the report will be given by the council on April 24th.

SAN FRANCISCO, CAL.—The railroad commission rendered a decision today granting authority to the Pacific Gas & Electric Company to expend a portion of the proceeds of the $5,000,000 of general and refunding mortgage bonds previously approved, upon the Bear River Canal development which the company proposes to undertake in Placer county. The Bear River Canal work contemplates the enlargement of the canal from its present capacity of 50 cu. ft. per second to a capacity of 350 cu. ft. per second. The water is to be used for irrigation purposes in Placer county. The cost of this additional work is placed at $500,000.

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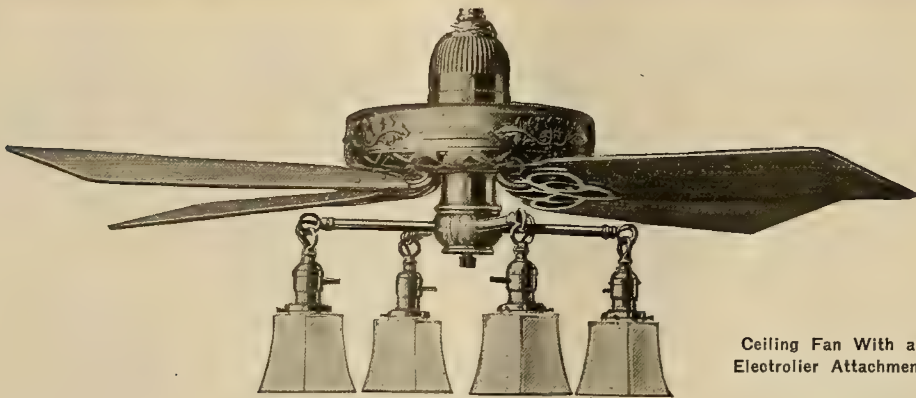
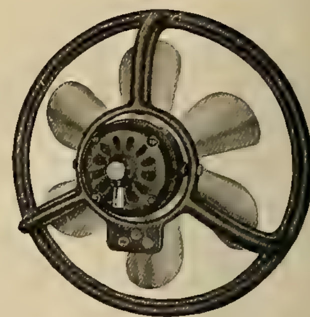
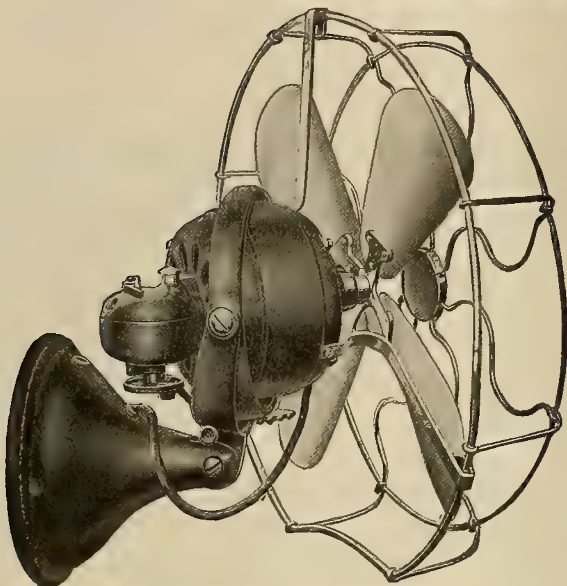


Ceiling Fan With an Electrolier Attachment



Exhaust Fan.



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G-E Fans are the most popular and largest sel line of fans in the country. The increasing dem for G-E Fans from season to season has establis their unrivalled reputation not only with the electr industry but with the user also. The quality resp sible for this acknowledged reputation and leaders will be maintained during 1913.

The field for G-E Fans is daily growing larger cause of the increasing number of wired houses; "Use Electricity" advertising campaign of which G Fans are a part is helping in this field. In addit

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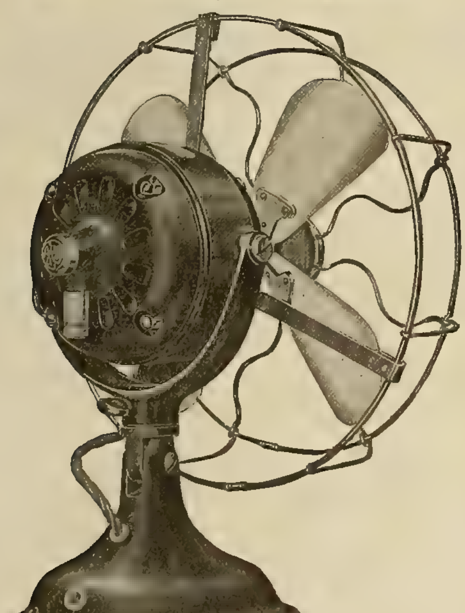
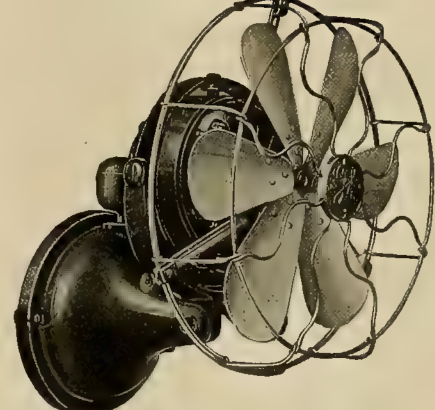
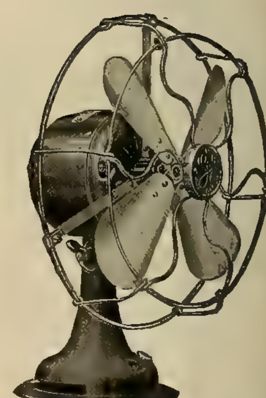
Pacific Coast Sales Offices in San Francisco, Los Angeles, Portland, Seattle and Spokane



Desk and Bracket Fan, Fixed Type.



6-Blade Residence Type Oscillating Desk and Bracket Fan.



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The Trade Mark of the Largest Electrical Manufacturer in The World.

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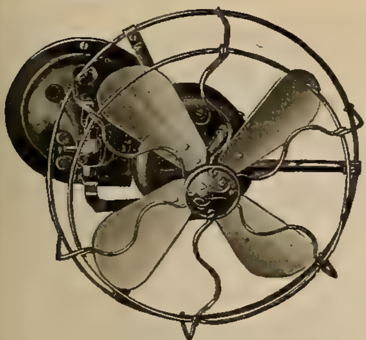

Telephone Booth Fan.

Ceiling Fan Ornamental Type.

Proven Quality

-E Fans will be advertised in over seven million copies
well-known magazines, such as the Saturday Even-
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unsey's, McClure's, World's Work, etc.

For all ordinary conditions the very complete line
G-E Fans will meet requirements, but where special
shes are desired to harmonize with any decorative
ieme, any color or finish can be supplied at slightly
ditional cost. Stocks already in the warehouses of
ur district offices in all parts of the country ensure
mpt delivery from the distributing point nearest you.

ic Company

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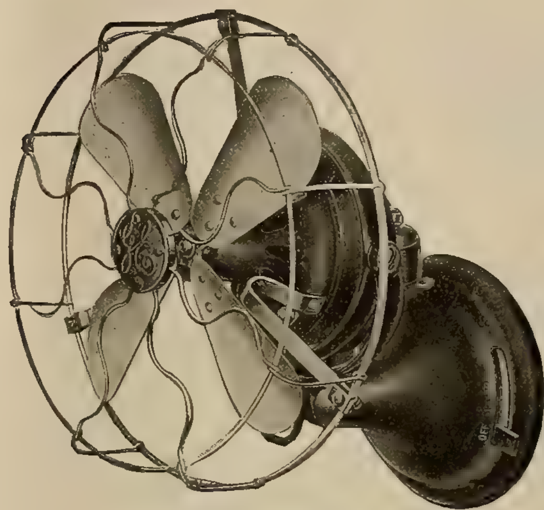
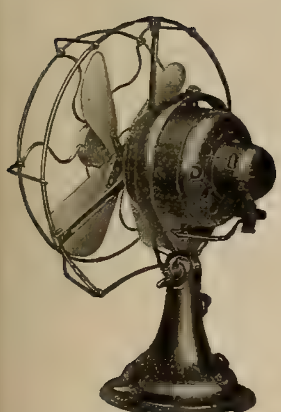
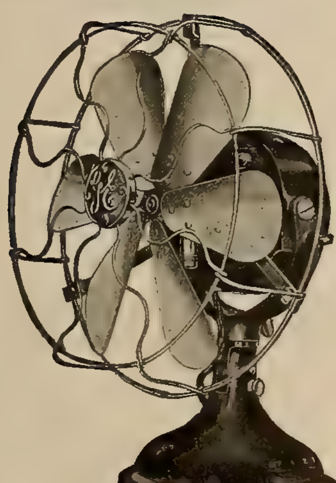


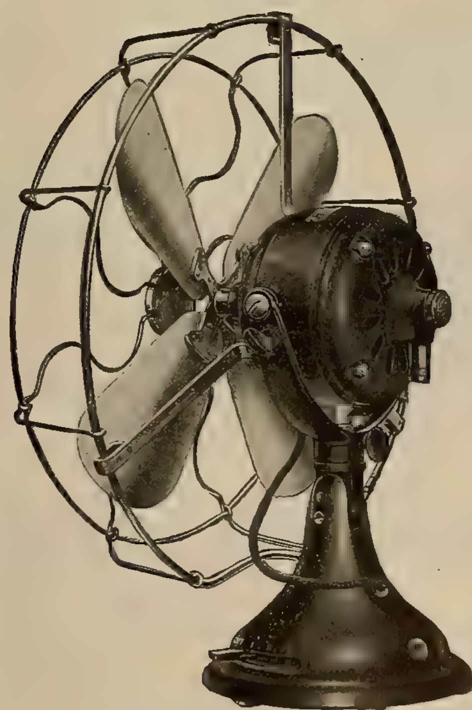
Oscillating Desk and Bracket Fan.



8-inch Oscillating Desk and Bracket Fan.



6-Blade Desk and Bracket Fan.



Desk and Bracket Fan, Fixed Type.

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Punched Disc


Rings and Punching Clamped by Forcing Over Edges of Cup.

Drawn Shell Construction for Small Alternating and Direct Current Motors

The illustrations show the principal steps in the construction of the "Drawn Shell" motor manufactured by the General Electric Company.

To all who possess a quick discernment for real values in goods electrical, "Drawn Shell" construction has many interesting features which become readily apparent from a close inspection of the product.

Uniformity of excellence in the material used for Drawn Shell motors is obtained through purchase in large quantities under rigid specifications. As the combined result of unequalled tool equipment, scientific manufacturing processes, the employment of expert workmen, and final testing under the supervision of the Designing Engineers, a practically flawless finished product is assured.

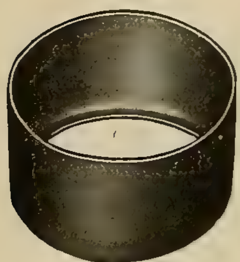
The satisfactory continuous operation at brake horsepower rating of all Drawn Shell Motors, with ample margin for reasonable overloads without sparking or overheating, is made certain by a careful, initial design and those niceties in mechanical and electrical construction, characteristic of all material bearing the trade mark "G-E".

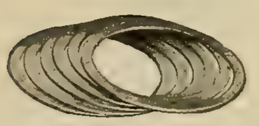
Drawn Shell Motors are used to drive small machine tools, pumps, compressors, vacuum cleaners, sewing and washing machines, etc., etc.—these sturdy little motors meet an infinity of power purposes for shop, factory, store, office or home.

Sizes 1/50 to 3/4 H.P.—with open or totally enclosed frames.

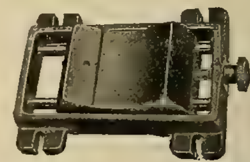
Bulletin No. 4963 giving a complete description of Drawn Shell Motors will be gladly sent on request to the nearest office of the General Electric Company.

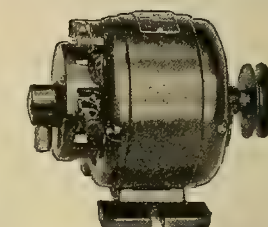

Cupped and Trimmed.

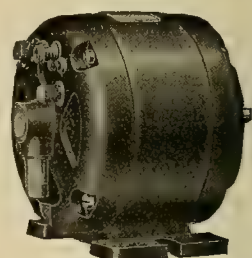

Blank Punched Out of Bottom.

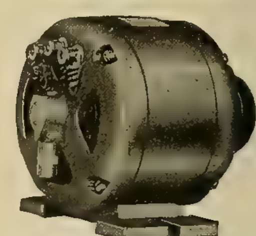

Spacing Rings.


Assembled Field Punchings for A. C. Motors.


Sliding or Plain Removable Base Furnished as Desired.


Type DSD Direct Current Motor


Type DSS Single-Phase Alternating-Current Motor.


Type DST Three-Phase Alternating-Current Motor.

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General Office: Schenectady, N. Y.

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of all kinds and all sizes, also Cable Accessories. *Get our prices before buying.*

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Large stocks carried at our Oakland Factory

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OKONITE TRADE MARK REG. U. S. PAT. OFFICE

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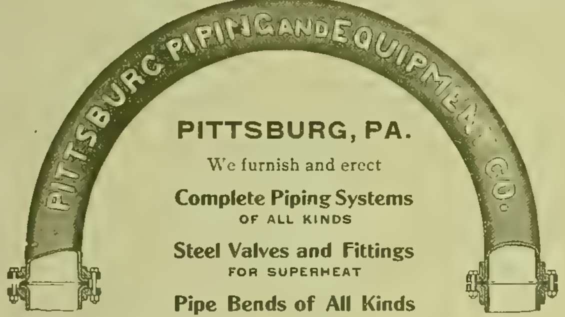

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OF ALL KINDS

Steel Valves and Fittings
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THE CHICAGO GRIP FOR INSULATED WIRE

No. 358-G	for No.	10	insulated wire or smaller
No. 358-I	" No.	4	" " " "
No. 358-K	" No.	00	" " " "
No. 358-M	" No.	0000	" " " "

This is a sure safe grip especially designed for handling insulated wire. All the coast supply and large hardware dealers will supply you. If not, write us

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RELIABLE
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EFFICIENT

"Pittsburg" Insulators

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Seattle Office, 115 Prefontain St. San Francisco Office, 247 Minna St.
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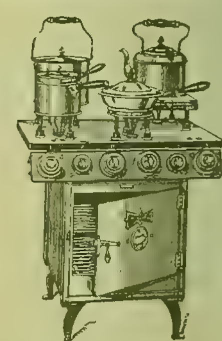

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

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Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX — SAN FRANCISCO, APRIL 26, 1913 — NUMBER 17

ELECTRICAL ENERGY IN THE OIL FIELDS

BY A. E. WISHON.[1]

After a year of hard work on the part of the engineers and electrical and power salesmen, the motor properly adapted for the oil fields of California was perfected to such a degree that a manufacturing company felt safe in selling it and the first customer, the Good Luck Oil Company, purchased three variable speed, Westinghouse oil well motors in July, 1910. This victory still lingers fondly in the memory of the power salesman, and may yet be written as an event in the life of some great man.

The Last Day of Steam on the Cheney-Stimpson Lease, California.

The promises that the motor would do all that the engine before it had done; that the central station service would be more continuous than any individual plant; and that current could be furnished by the hydroelectric companies at such a price as to allow a saving over former operating costs of 50 to 75 per cent, which, at that time, were "taken with a grain of salt," are today substantiated by the actual operating results of 39 oil companies that are driving by electricity 669 pumping wells.

The number of motors that will be installed during the coming year depends principally on the number that can be furnished by the electrical manufacturing companies and should, conservatively, number 1200 pumping motors, exclusive of drilling motors,

[1]Assistant General Manager, San Joaquin Light & Power Corp.

compressor motors, field pumps and other forms of electrical drive now commonly used throughout the oil fields.

Of the 669 pumping wells now operated by electricity, 50 in the Coalinga field are operated by individual motors and 20 by a single motor and jack. In the Midway field 304 pumping wells are operated by individual motors. In the Kern field there are 83 individual motors, and 23 jack motors, which operate 212 wells. There are also 6 drilling motors in operation in the different fields. To operate air compressors an additional motor capacity of 605 h.p. is now being installed.

The orders for electrical equipment did not come with the rush that might be suggested by the above figures, for while the Good Luck motor installation was made in July, 1910, it was the middle of the

The Twenty-Inch Bit for Sinking Oil Wells.

summer of 1911 before any other contract of any consequence was signed. The field, at large, wanted actual operating conditions and operating costs proven, and a reasonable period of time to show what the motor would do in the heat and dust and under the severe treatment it would receive in the oil fields was necessary.

A simple tribute was recently paid the original motor, when a party of engineers visiting the field asked of the operator: "What have you done to this motor?" He replied: "We have oiled her."

The individual pumping motor, the first form of electric drive to be adapted to oil well operation, is the method that will predominate in the oil fields for years to come. This requires a motor to each well, but where the amount of oil to be pumped is of any great quantity or if the rods are to be pulled often, or the well requires "agitating" occasionally, such an installation is necessary.

Constant speed, two-speed, one speed-variable speed, and two speed-variable speed motors are now being used; the constant speed only in a few places, as it is limited in its scope of use, on account of the lack of flexibility in operation. Both types of variable speed motors have the star-delta combination and give, not only an absolute variable speed but 10 or 30 h.p. rating. The 10 h.p. or star is used in pumping; the 30 h.p. or delta in pulling rods and cleaning. Both back geared and belted motors are used but the belted types are the more common. Each type of variable speed motor features certain points, as a matter of salesmanship, and each has its long list of admirers. Both are operating satisfactorily, and the selection between the two becomes much the same as the selection of any other standard electrical machinery—a matter largely of personal opinion—safe in either choice.

Delivery is the now all important point in the placing of the motor order, though of course first cost is always given due consideration. However, the manufacturing company and the hydroelectric companies interested have largely eliminated first cost as a counter argument, by offering to install so that the equipment is paid for out of the saving made over other forms of power previously used. Such a proposition must necessarily be founded on substantial figures.

I can best give the idea of the cost of a property electrically equipped, complete, ready for operation, by the following figures. The lease in question is an average property, with wells 150 to 300 ft. apart.

Primary and Secondary Lines.

14 35 ft. poles	$ 112.00
12 Style D cross-arms	9.60
19 Style G cross-arms	11.40
36 10,000 volt insulators	4.68
72 2,000 volt insulators	2.88
48 1 in. iron pins	9.60
60 Locust pins	1.20
12 28 in. cross-arms braces	1.32
36 ½ in. x 3½ in. lag screws	.54
33 ⅝ in. x 16 in. bolts	2.31
6 ⅝ in. x 14 in. bolts	.39
6 lbs. ⅝ in. washers	.30
10 anchor rods	7.50
10 slugs and washers	7.20
10 pole tins	.35
10 No. 855 strain bobs	.70
500 ft. ⅜ in. guy wire	5.70
20 3 bolt clamps	4.00
5500 ft. No. 8 H.D. wire	45.39
2800 ft. No. 3 H.D. wire	73.43
2500 ft. No. 4 H.D wire	52.80
100 ft. No. 8 S.D. wire	.80
150 ft. No. 6 S.D. wire	2.10
Cost of delivering material	30.00
Labor	170.00
	$553.95

Three transformers and installation for six wells:

3-15 kw. 6600-440/220 v. transformers	541.95
Type H transformer construction material	43.61
Labor	40.00
	$ 625.56

Installing six 10/30 oil well motors:

6-10/30 motors and jack shafts f.o.b. warehouse	$3336.00
Material for wiring in	422.88
Labor	90.00
	$3848.88

Summary:

Primary and secondary lines	$ 553.95
3-15 kw. transformers and installation	625.56
6-10/30 motors complete	3848.88
	$5028.39
Average cost per well complete	$ 838.065

This $838 per well is generally saved in from six to ten months and after that the saving goes in to top off the regular earnings as "velvet."

The above figures are taken from an actual bill rendered to a property for labor and equipment. However, this is a small property and on the large properties, where they buy direct in large quantities and have their own organization, these figures can be cut materially.

As this was not started as a comparative cost article, I will simply state that continuity of service, (eliminating great loss of production due to shutdowns) saving in boiler or engine repairs, saving in water and fuel, saving on interest of initial cost, 50 per cent saving on depreciation, the same on labor, saving on lubricating oil, etc., are a few of the points of salesmanship. However, the all convincing argument is the inspection of the books of the different oil companies that have tried all forms of power. This added with talks with the field superintendents, drillers, and pumpers of the electrically operated oil properties is always effectual.

The figures shown in the following table are for the month of February, taken from 100 wells without regard to choice. The names of the companies are withheld but a visit to the field office or a personal letter to most any company will bring you parallel figures of cost:

Oil Well Motor Individual Drive—Pumping Statement.

Date, 1913. From To Jan., Feb.	Total power consumed Kw.-hr.	No. of Wells.	Average kw.-hr. per well per Day.	Total production in Bbls.	Kw.-hr. per bbl. Pumped.	Ave. bbl. daily produced per Well.	Ave. Depth of Well.
30 days....	3,825	1	123.4	1,741	2.197	56.2	3,110
" "	1,720	2	27.7	870	1.977	14.0	1,706
" "	10,290	3	109.3	2,227	4.580	23.9	2,775
" "	8,970	3	96.5	12,107	0.741	130.2	2,621
" "	9,975	3	107.3	17,350	0.575	186.6	1,103
" "	18,000	8	72.6	3,898	2.023	35.9	1,030
" "	3,500	1	120.1	4,640	0.754	160.0	1,700
" "	7,152	2	123.3	8,730	0.819	151.0	950
" "	6,340	2	102.3	1,085	5.843	17.5	2,205
" "	5,000	2	80.6	3,050	1.639	49.2	2,474
" "	8,560	5	55.2	2,090	4.096	13.5	1,384
" "	36,575	12	98.3	85,384	0.429	229.5	958
" "	35,375	12	95.0	64,656	0.547	173.8	1,339
" "	8,816	4	76.0	12,000	0.735	103.5	900
" "	17,670	5	114.0	12,845	1.376	82.9	2,665
" "	35,230	11	103.3	47,964	0.735	140.7	1,953
" "	2,995	1	96.6	1,860	1.610	60.0	2,692
" "	24,240	8	101,0	41,400	0.585	172.5	1,040
" "	14,010	9	50.2	2,869	4.883	10.3	1,029
" "	10,088	4	80.4	8,467	1.191	66.1	2,619
" "	4,448	2	76.7	5,800	0.766	100.0	900
Average ..	272,779	100	90.92	341,033	0.799	113.67	152,658

This table gives about the best idea that can be obtained as to the power required in the operation of the oil well. However, the gravity of the oil, the amount of gas in the well, whether or not the hole is straight, and a hundred and one other factors, enter in to make one well require slightly more or less power than the neighboring well.

Since the introduction of the electric drive, there has been much more attention given to the set-up of the standard rig itself, especially as to the band-wheel and walking beam bearings. Counter weights are now being used on the walking beams to work opposite the weight of the rods, and a study is being made to eliminate as far as possible the friction load that has always existed in the standard rig, thus largely reducing the power required to operate. In many instances tail pumps are connected to the walking beams, and this last winter, during the cold spell, many companies were made aware that cold weather made a material difference in the amount of power required in the operation of an oil well. Heretofore, figures have not been kept close enough by many companies to appreciate this, the oil simply having been run out of the wells and burned under the boilers, without being measured. With the integrating wattmeter, however, all the inefficiencies existing in any part of the equipment, even down to the pump 2000 ft. below the surface of the ground, are brought out and placed vividly before the operator, who, having it thus called to his attention, is making a closer study of efficiency of operation.

The older wells that are more or less free from sand troubles and that are waning in production, but that are free from water troubles, are being operated largely by jacks. The jack is a power-head, built on the theory of an eccentric that is generally

Electrically Operated "Jack" House on Canfield Lease, Kern River Field.

situated in the middle of a group of wells and at different points on the eccentric yoke. Cable lines are connected and each in turn is tied to a rocker-beam at the well-head. Motor drive has been recently introduced to operate these jacks, and the saving made here is as much, if not more, than that made in the individual oil well motor. The ordinary constant speed motor can be used to operate a jack. It is generally connected to the jack-shaft through a friction clutch, in some instances driving the friction clutch by a Morris chain drive but more commonly with the ordinary leather belt. The outfit is simple and the installation cheap, as no special electrical apparatus is required, other than the ordinary constant speed motor.

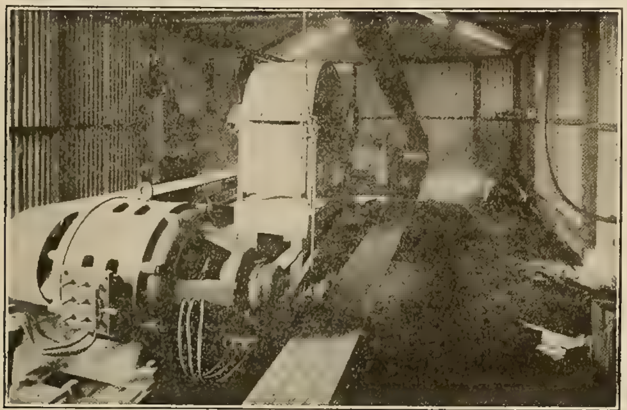
Oil Well "Jack" Drive—Pumping Statement.

1913. Time.	H.P. of motor.	Total power consumed kw.hr.	No. of wells.	Average Kw.-hr. per well per day.	Total production in bbls.	Kw.-hr. per bbl.	Ave. daily Prod. bbls. per well.	Depth of well.	Gravity.
30	15	8,352	7	39.7	3,300	2.52	15.7	779	14
30	25	9,048	8	37.57	3,930	2.30	16.25	818	15
30	30	14,212	14	31.9	10.080	1.41	24.	725	16
30	35	8,897	8	37.06	5,328	1.67	22.2	970	15

While the current required to operate a well by a jack may be shown to be approximately a third as much as that required to operate the average indi-

vidual motor driven well, the kw.-hr. per barrel of oil pumped with a jack is as much, if not more, than that pumped by individual motors. The reason is that the jack well generally produces very few barrels of oil per day and a large part of the power is taken up on constant friction load.

In a large part of the Kern field and scattered throughout the other fields, water has gotten into the oil sands, so that to actually produce a barrel of oil it is many times necessary to pump ten barrels of solution, and with the ordinary type of walking beam pump this is impracticable and in many cases impossible. The problem has been solved by use of the air compressor, whereby an air line is run down inside of the well and compressed air is forced to the bottom of the well, thus forcing the liquid to the surface and making it possible to operate wells that otherwise could not be made to pay. To electrically operate the air compressor is nothing new, the constant speed motor being used. This class of business seems to offer one of the best fields for electric power. The installation for this service generally ranges from 100 to 400 h.p. and the load is continuous —24 hours a day.



Drilling Motor in Operation on 20-Inch Well at K. T. O. Property, Midway Field, California.

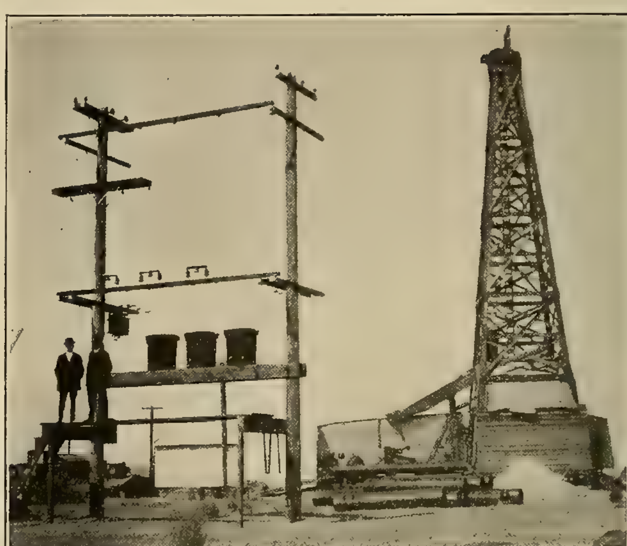
The development of the drilling motor has not advanced as rapidly as that of the pumping motor; first, because it was not seriously undertaken until nearly a year and a half after the pumping motor had been installed, and second, because the motors have cost more to develop and the duty required of them has been so severe as to make the manufacturing companies cautious in bringing more than one type of motor out at a time. However, the recent drilling motor that has been brought out seems to have solved the problem. From the very start the drilling motor proved itself to be the cheapest drive for this purpose and the advantages of such power, especially where the drilling was to be done on the frontier, where water and fuel must be hauled over impassable roads, appealed greatly to the oil man. The chief objection to the earliest type of drilling motor was its inability to bring about the fineness in control that is required by the driller, but at the present time several forms of control are being used. These give any desired speed and the drillers now working with the electric rig are heartily in favor of it.

Recently the General Petroleum Company drilled a well 1356 ft. in 37 days, consuming only 9632 kilowatts. At a cost of 1½c per kw.-hr., the total power bill for the well was $144.48, or a fraction over $3.90 per day. The Santa Fe and several other companies have obtained similar results. At the present time the K. T. & O. Company are giving the drilling motor one of the most severe tests it could be put to, namely the drilling of a 20-inch well. This well is being drilled in the Maricopa flats, directly east of Kerto, and is being watched closely by all the operators in the field.

While the question of operating costs in the drilling of wells is generally not given the consideration paid to pumping, on account of the drilling process taking only a brief period of time, the saving in dollars and cents made possible by the drilling motor and the many problems that will be eliminated by its use, will necessarily make it as popular as the pumping motor within the next few months.

The price charged for electric power throughout the oil fields, measured on the secondary side of the field transformer, varies from 1c to 1½c per kw.-hr., according to the number of wells operated by the company, or from $4.00 to $5.50 per h.p. per month, graphic meter measurements.

Another use of electricity that is becoming quite pronounced in the oil field is the electric dehydrating plant, where oil that carries finely disseminated particles of water is electrically treated, thereby separating the water from the oil and greatly increasing its value for marketing purposes. Roughly describing it, the plant consists of cylindrical, galvanized iron tanks, in which is immersed a wire cone. The current is stepped up to approximately 10,000 volts discharged from this cone through the oil to another electrical terminal. The high voltage and the electrolytic action collects the finely disseminated particles



A Twenty-Inch Oil Well Being Electrically Drilled on Maricopa Flats, Midway Field.

together by breaking down the fine filaments of oil that surrounds them, and when the particles are collected into globules of sufficient size, the rest of the process is simply a matter of the water settling to the bottom on account of the difference in gravity, where it is drawn off.

The following is a statement of the operating

Cost—Dehydrating Plant—December, 1912.

Barrels of oil treated		40,000
Barrels of cleaned oil resulting		34,650
Before treatment oil averages 16 per cent wet; after treatment 2 per cent.		
Royalty for month		$460.17
Power for treating, operating of machinery, and lights.		82.28
Labor—Proportion of gager's salary	$100.00	
Cost of heating oil, incidentals, etc.	50.00	150.00
		$692.45
Depreciation (cost of plant $6600)		82.50
Total		$774.95

Cost per Barrel of Cleaned Oil.

Royalty	$ .0133
Power	.0023
Labor and expense for bags, heating, etc.	.0043
	$ .0199
Depreciation	.0023
Total	$ .0222

The oil well pumping motor, the drilling motor, the air compressor motor, the jack, and the dehydrating plant are at the present time the most important users of electricity in the oil fields, but the sump pump,

The Reward Electrical Dehydrating Plant.

[This plant treats 800 bbls. of oil per day, removing the water from oil to 1/10 of 1%, thereby raising the gravity of the oil as much as two degrees. After once put in operation, the machine needs no attention whatever.]

the line pump, shop motors, motors for refrigerating plants, motors for water wells, etc., are gaining in number each day. Practically every property of the field is electrically lighted or is arranging to light its derricks and camps with electricity.

This stage of the oil game may consistently be termed the "electric epoch." Times have changed since 1910. Today the electrical salesman listens to the oil operator's story of the motor's success, and it is indeed an inner satisfaction when he has heard it.

CHAIN OF WIRELESS STATIONS.

It has been decided to construct five wireless telegraphic stations in the British Crown Colonies and the British East Africa Protectorate. These stations, which will be small-power stations, of the order known as ship-store stations, will be established at Barbados, Mombasa, Penang, Singapore, and Hongkong. Tenders have already been received, and it is understood that, subject to the necessary guarantees, the work will be given to the Anglo-French Wireless Company, the English branch of the Goldschmidt Company.

FRICTION AND WINDAGE BY THE DECELERATION METHOD.

BY BEN D. MOSES.

Often it becomes essential to know just exactly what the friction and windage losses are in some rotating machine. The two losses are usually spoken of jointly, as their individual magnitude, the object of which every design is to keep at a minimum, is taken care of by a joint correction, and therefore will be taken up as a single loss. Their separation is, however, not difficult in most cases.

It will not be the purpose, in this article, to delve too deeply into the theory underlying each operation, but to take certain relations for granted and show by means of an experimental test, a method of determining the above mentioned loss.

In the case of a body rotating on an axis the power is defined as the product of the moment of inertia into the angular acceleration and angular velocity, or expressed symbolically

(1) $P = I\,a\,\omega$

P = power, I = moment of inertia about the rotation axis. a = angular acceleration, and ω = angular velocity.

If, however, the above general case be reduced to the specific one in which power is expressed in horsepower (h.p.), moment of inertia in ft. lb. units, and a and ω are in terms of revolutions per minute (r.p.m.)

Since $a = \dfrac{d\omega}{dt} = \dfrac{2\,(3.1416)\,dN}{60dt}$ in which dN and $d\omega$ are changes in angular velocity during the time interval dt seconds.

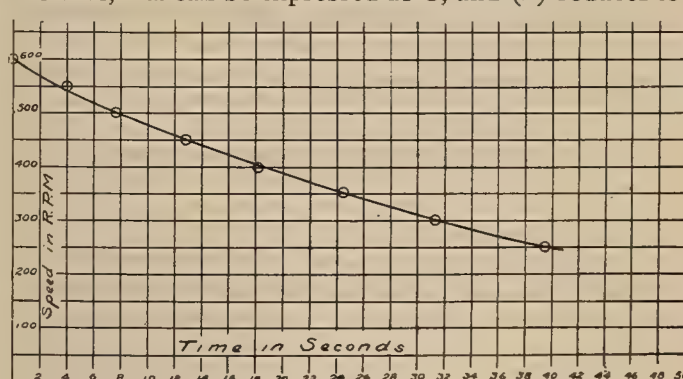
Equation (1) reduces to

$$\text{(2)}\quad \text{h.p.} = I \times \frac{4\,(3.1416)^2}{1{,}980{,}000} \times \frac{dN}{dt} N$$

$$\text{or h.p.} = KI \frac{dN}{dt} N$$

K being the constant expressing the value of the fraction. $\dfrac{4\,(3.1416)^2}{1{,}980{,}000}$

The moment of inertia being a constant for any one case, K.I can be expressed as C, and (2) reduces to



The Deceleration Curve Determined by Experiment.

$$\text{(3)}\quad \text{h.p.} = C \frac{dN}{dt} N$$

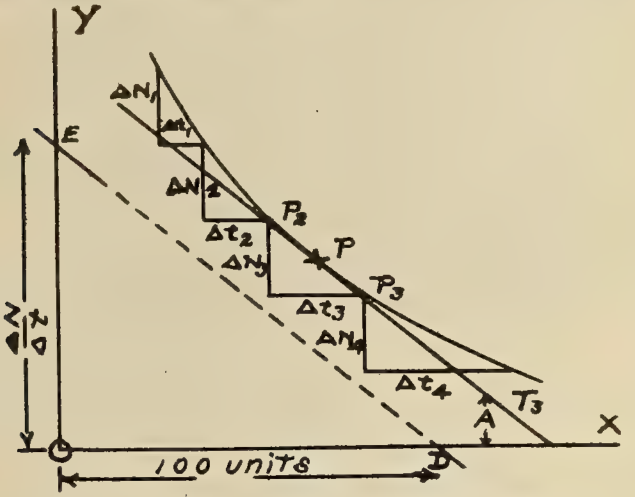
$\dfrac{dN}{dt}$ is left in this form for the reason that $\dfrac{2\,(3.1416)\,dN}{60\,dt}$

costs of a dehydrating plant, showing the cost per barrel of oil treated:

is an approximation of the angular acceleration, its accuracy depending on how small the dt be chosen.

Equation (3) then is an expression for the horsepower which can be determined for any speed N, providing $\frac{dN}{dt}$ can be determined. Our problem then resolves itself into one of the determination of the value of this important ratio.

One very satisfactory process is that known as the Deceleration Method.



Graphic Theory of the Deceleration Factor.

The wheel to be tested is belted to a motor in such a manner that the belt can be thrown off at any time without incurring damage, and the rotating wheel left to the tender mercies of the friction of bearings and air. An indicating speedometer or tachometer gives the speed during the slowing down. If at intervals during this deceleration the time and speed be taken a time speed curve can be plotted (see Fig. 1.)

Let us consider this curve, an illustrative portion of which is shown in Fig. II. Assume dN to be the same for each computation. Then the corresponding dt will be shown by the resulting abscissal increase. It is seen that $\frac{dN}{dt}$ is the tangent of the angle A for each case. If then 100 units be laid off along OX and a parellel drawn to the tangent, as T_3, for the $\frac{(dN)}{(dt)_3}$ through the 100th division, D, the value of the ratio will be OE, to the same scale. This line drawn through P_2 and P_3 is approximately, the tangent at P where the speed is the arithmetical mean between that at P_2 and P_3.

Everything now is known and all that remains is to "work" the curve (Fig. III), from which the power consumed in windage and friction for any speed can be read.

A representative test will illustrate possibly more clearly.

Test for Windage and Friction.

Apparatus:

(1) 30 in. water wheel.
(2) 5 h.p. d.c. motor belted to wheel pulley.
(3) A tachometer.
(4) A chronograph with short circuiting key.

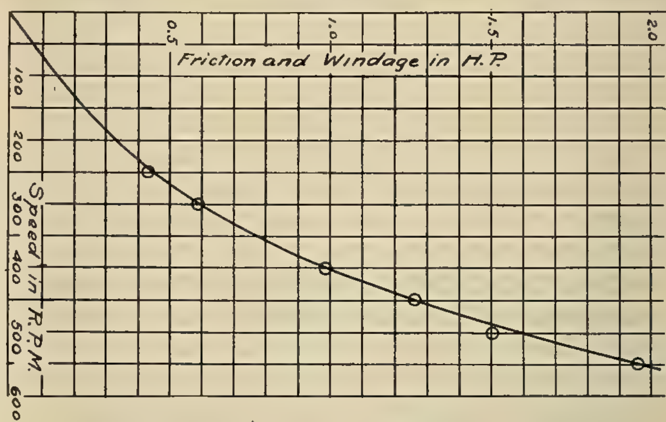
Observations, Data and Computations.

I of the wheel was obtained by the pendulum method and found to be 6.90
I of shaft, pulley, splash guards, etc., by direct measurement 7.40

Total I 14.3

$$\text{So that } C = \frac{d\ (3.1416)^2}{1{,}980{,}000} \times 1.43 = .000286$$

The chronograph, ticking seconds on a traveling tape, was short circuited, marking time on the tape, by an observer at the tachometer just as the needle passed over each 50 mark. Six tapes were taken and their average alone used. The belt was thrown off at 600 r.p.m.



Curve Showing Friction and Windage Losses as They Vary With Speed Fluctuations.

The following is a condensed table of observations and results:

Sp, (Speed in r.p.m.)	Time to slow down, in seconds.	$\frac{dN}{dt}$ from time speed curve.	H.P. = $CN\frac{dN}{dt}$
600	0		
550	4.07	12.45	1.96
500	7.79	10.55	1.51
450	12.91	9.80	1.26
400	18.29	8.59	0.982
350	24.44	7.55	0.755
300	31.38	6.79	0.582
200	39.53	5.76	0.435

ELECTRIC VEHICLES.

By J. Harry Pieper[1]

The central station interests have been more alert than ever before to the possibilities of greatly increased business by the development of the electric truck business. In some cities, Chicago for instance, there has been a reduction of practically twenty-five per cent in cost of electric current for battery charging. But the aggression has gone further from these central station interests; they have in Boston developed the electric garage business; they have carried out co-operative advertising schemes, and they have established clubs where every pro and con in the development of the electric commercial business has been gone into with satisfactory results. There has been much done in the field of battery improvement. The last year or so has witnessed amazing battery activity. Some of the makers have shown exceptional activity in perfecting their product, so they now feel

[1]Engineer Illumination and Vehicles, Southern California Edison Company.

sufficiently confident to place a definite guarantee covering a period of years use and also give definite facts on cost of maintenance. This development has had a very salutary effect on the buyer, and has increased his confidence in the electric vehicle.

Tire cost is being slightly reduced, although it is excessively heavy in some cases. This is largely a local problem, being greatly dependent on the street pavement, the amount of overload, the driver and the tires themselves. Tire makers are active today, but there remains much for them to do.

Although much has been done in ascertaining costs on electric vehicle operation in various fields, there still remains a wide difference in cost of delivery by firms located side by side in the same cities and delivering over practically the same residential sections. One of the stores has delivered packages at a cost of 10 cents each, the other at 6 cents each. Both vehicles were operating in house to house delivery averaging from 100 to 150 packages per day, with a mileage of forty or fifty, and sometimes as high as seventy-five in busy season.

These facts alone show that there is still much to be done in this field. One concern has developed a wagon design that saves nearly $10 a day by facilitating, as it does, the handling of packages in loading and unloading.

During the past year it has been satisfactorily demonstrated to department stores that the 1500 pound and one ton electric vehicle are well adapted for house to house delivery, and that they are quicker and cheaper than horses in this work. The electric machine is the one for house to house delivery—loading platforms have been improved to facilitate loading, and the driver has been educated within the year so he realizes that by selecting the best streets he can add many miles to the battery charge and save the battery and tires as well.

Ever since some of the larger manufacturers of gasoline commercial vehicles, started to make electric commercial vehicles, it has been generally admitted that 70 to 80 per cent of all city and suburban service demands electric vehicles. This is especially true where the service includes short hauls and many stops or the employment of drivers who formerly drove horses.

There are forty-eight manufacturers of electric trucks in this country, ten of these coming into existence during the past year. All of these manufacturers had exhibits at both Boston and New York shows, and special attention and advertising was given to the commercial section which, it is expected, will have a good effect on future business. An important point made at a recent convention of the Electric Vehicle Association of America was the folly of comparing the electric with gas truck. These two kinds of self-propelled vehicles should not be engaged in civil war, but rather should be united in battling with the horse. It is the latter which is to be eliminated. The electric of today is a machinery unit designed and perfected to do a definite work, and is no more a compromise than is the gasoline truck, freight hauling steam engine or transatlantic freighter. Its field of application is as exactly defined as is the field of each of these.

General conditions have been good in the electric vehicle business, and there is a tendency at the present time towards the purchase of electric trucks singly rather than in fleets; this shows the small merchant is buying.

The need of better trained and more dependable men for electric vehicle garage work as generally applied to the industry was responsible for the suggestion some months ago to the president of the Electric Vehicle Association of America that this association endeavor to find relief for that situation.

There were 635 electric vehicles registered in California from September 1, 1911, to September 1, 1912. In the year from January 1, 1912, to the present time there have been approximately 300 electric vehicles registered in Southern California. Of these 200 are being charged off the lines of the Southern California Edison Company, and as most of these machines are charged between 10 o'clock at night and 6 o'clock in the morning, a time when the lines are least loaded, you can easily realize what desirable business this is. There are eight electric trucks now in use in Los Angeles independent of the ones owned and operated by this company, and they are all being charged with Edison "juice." The Broadway Department Store is installing an electric wagon, and if it works as satisfactorily as is expected it will, it means the installation of twenty-three wagons. The American Express Company has two two-ton trucks now in operation here with two more to follow. Wells Fargo & Company have ordered seventy-six vehicles, and I have been given to understand that four of them are to be assigned to this city.

The electrification of our city merchandise transportation systems now presents a consumer of great possibilities. Commercial conditions are now requiring a more rapid transfer of merchandise, and in the large cities the congestion of merchandise is becoming a serious problem. The electrical system applied to trucks offers advantages over the gasoline in many respects. The electric motors being more simple in construction, are more durable and efficient than the gasoline engine. Batteries have been improved and their efficiency greatly increased in the last few years.

The size of the motor and number of cells in batteries limit the speed of an electric truck, which acts as a check on reckless driving and insures slower and more uniform speed and results in a lower maintenance cost.

The successful introduction and wide use of these vehicles depends upon the education of the public in their proper application and care.

An educational campaign and some expert assistance is needed so that the vehicle used may be adopted to the purpose and service demanded of them.

One by one the obstacles that have been in the way of commercial vehicle installations have been overcome, and now the road seems clear; some red blood has been injected into the local situation, a public electric garage is to be opened that will be equipped to charge all sizes and types of electrics, and three of the manufacturers of electric trucks who manufacture commercial vehicles exclusively, are coming here with agencies and wagons for demonstrations,

ELECTRICAL PUMPING AND IRRIGATION

CHUTES OR RAPIDS AND STREAM CROSSINGS

BY B. A. ETCHEVERRY.

Small Reinforced Concrete Drops; Carlton Lateral, American Beet Sugar Company, Colorado.

These drops were constructed during the fall of 1908 and are good examples of the use of concrete for small structures. Seven drops were constructed, varying in height from 2¾ ft. to 7 ft.The same type of drop and same dimensions were used for all heights of all with the exception that the concrete beam extending between the side wall was used only for the drops 7 ft. and 6½ ft. high. This beam acts as a strut to resist the thrust from the side walls. All drops are reinforced with a central web of hog wire fencing well lapped or wired together at all angles and corners.

The itemized cost of construction for three different sizes is given in the table below. The amount of concrete has also been estimated. The mixture used consists of 1 part of cement to about 6 of sand and gravel. The cement cost about $1.46 a barrel and the gravel (screening and hauling), averages about $2.10 a cu. yd.

Cost of Drops on Carlton Laterals.

Item.	Height of fall— 2¾ feet.	4 feet.	6½ feet.	7 feet.	Average unit cost per cubic yard.
Amount of concrete....	10 cu. yds.	10½	11¾	12¼	1 cu. yd.
Labor:					
Excavating, men and teams	8.75	15.85	14.25	30.72	1.563
Carpenter work on forms..	10.95	8.40	12.55	14.50	1.043
Screening gravel	5.04	5.77	7.12	7.61	.574
Hauling gravel	12.97	14.87	18.35	19.61	1.478
Mixing and putting concrete	15.75	13.80	23.87	18.90	1.625
Miscellaneous	6.95	7.96	9.83	10.51	.792
	60.41	66.65	85.97	101.85	7.075
Material:	41 bags.	47 bags.	58 bags.	62 bags.	
Cement	15.04	17.24	21.28	22.74	1.715
Lumber	3.82	4.38	5.41	5.78	.436
Nails	.30	.35	.45	.45	.035
Wire netting	1.	1.14	1.41	1.51	.113
Cement for patching and plastering	.14		.14	.15	.011
	20.32	23.11	28.69	30.63	2.310
Engineering	20.55	23.56	29.08	31.08	2.343
Total cost	101.26	113.32	143.74	163.56	11.728
Cost per cu. yd.	10.12	10.78	12.25	13.35	

The low cost of these concrete drops compares very favorably with the first cost of wooden drops; the concrete has the additional advantage of durability.

Chutes or Rapids.

When the slope of the country is very rapid, or when there is a sudden drop in the level of the country and especially for small canals, it is frequently more economical to use a chute instead of drops. These chutes or rapids will consist of an open concrete lined canal built on the grade of the country, or of a pipe. When an open canal chute is used the inlet is a transition in which sufficient drop is given to acquire the velocity corresponding to the grade of the chute. For any change in the grade in the chute itself, the change in velocities must be provided for. The outlet of the chute must be designed to resist and destroy the high velocity of the escaping water. For this several devices are used. The commonest are: (1) basins formed by a gradual enlargement with a raised floor of a cross wall to form a water cushion; (2) baffles or vertical posts or surfaces which the water strikes.

Inlet to Small Pipe Chute, Umatilla Project, Oregon.

An efficient type of pipe chute for small volumes of water is used on some of the laterals of the Umatilla project, Oregon. This consists of an inlet box made of 30-inch pipe, 4 ft. long, and a similar outlet box, connected together by a smaller size pipe. The inlet is made by riprapping the slope of the canal around the pipe so as to form a funnel shaped entrance. The outlet is also riprapped and the water escapes out of this funnel shaped outlet with its velocity very much diminished so that there is practically no scouring.

Outlet to Pipe Chute with Sheet Metal Baffle, Truckee-Carson Project, Nevada.

Drainage or Stream Crossings.

The drainage water encountered in creeks or natural drainage lines may be crossed in five ways:

1. By passing the canal over it, usually by means of a flume.

2. By passing the canal under the drainage water by means of a siphon or culvert.

3. By allowing the drainage into the canal or by a level crossing.

4. By passing the drainage water under the canal by means of a culvert.

5. By passing the drainage water over the canal by means of a flume.

The first four methods are those commonly used. The fifth method is very seldom used. The types of structures used are: Level crossing, flumes, siphons, culverts.

Level Crossings.

A level crossing is formed by allowing the drainage water into the canal and either carrying it in the canal or passing it through the canal. The following conditions will control the design of the crossing:

1. The drainage water occurs during the irrigation period when there is a deficiency in the available water supply. In this case the drainage water is valuable in supplementing the deficiency and at least part of the drainage water can be carried along in the main canal and the excess wasted through the canal either at a point directly opposite the inlet or at some wasteway below if the carrying capacity of the canal down to that wasteway is sufficient.

2. The drainage water occurs during the non-irrigating period and is not in excess of the carrying capacity of the canal. In this case it may be carried in the canal to the nearest wasteway or may be passed through the canal.

3. The drainage water is far in excess of the carrying capacity of the canal. In this case the drainage water is passed through the canal. A level crossing may be formed by damming the drainage channel or depression so as to form a basin into which the canal water enters and mingles with the drainage water. When the basin so formed is of sufficient size it may act as a storage and regulating reservoir or a settling basin into which the sand and silt may be deposited. It may be necessary to provide a wasteway.

The usual type of level crossing will consist of the inlet made in the upstream bank of the canal and

Level Crossings with Drainage Channel on Main Canal, Umatilla Project, Oregon.

the outlet made in the downstream bank. The inlet is similar in construction to an overflow spillway. The outlet is either an overflow spillway or a wasteway. The canal between the inlet and outlet must be protected by paving or concrete lining. For small volumes of water the inlet may be made by a pipe passing through the bank or canal.

ACCOUNTING UNDER UTILITY REGULATION

OPERATING EXPENSES DEFINED. III.

BY JOHN A. BRITTON.

By expenses of a corporation, are meant such expenses, as are necessary to the maintenance of the corporate organization, the rendering of services required or authorized by law, the sale of merchandise, the production (including herein capital consumed), the disposition of commodities produced and the collection of revenue therefor. Capital consumed however is included under "repairs" or "maintenance."

Expenses are also divisible into general administrative, fixed charges and operating expenses. Fixed charges are applicable to the operations generally, and include expense of general offices, general amortization of capital, general taxes, etc., and all other income deductions and appropriations against gross and net corporate income, while operating expenses are applicable to the operation of plants and properties, by which electricity is produced and distributed, and revenues collected therefor.

All expenses of operation—other than general administrative—incurred in the rendering of services and production, the disposition of commodities, within the purposes of the corporation and within the divisions and districts, shall be known as divisional expenses.

Divisional expense is divisible into departmental expenses of the Electric Department, Gas Department, Water Department (collection), Water Department (pumping), Steam Sales Department, and Supply Departments.

All expenses incurred in the production and purchase of gas, the disposition of, and the collection of revenues therefor, shall be termed "Gas Department expense." This expense is again divisible into generating expense, gas purchased expense, transmission expense and distribution expense.

Generating expense includes all expenses incurred in the production and storage of gas.

Gas purchased expense includes the cost, at point of delivery, of all gas purchased from other corporations for distribution to general consumers, or the proportion of the cost of production (including maintenance, but not including any pure rent or return upon the value of property employed), of gas produced by another corporation for distribution under joint arrangement for the sharing of expenses, upon the basis of the relative amounts of benefit to the several participants. This does not, however, include inter-company gas purchased.

Transmission expense includes all expense incurred in conducting gas from the holder outlet to the connection with the distribution system and raising the pressure above works' pressure.

Distribution expense includes all expense incurred in delivering gas from the holder or trunk line connection, to the house pipes or appliances of the consumers and the collection of revenues therefor.

Generating Expenses.

Charge to this account the following sub-divisional expenses:

(1) **Steam Plant:** All material and labor expended, in the production of steam for supplying gen-

erators, and for operating all steam driven apparatus used in gas generation. This should include such supplies as gauge glasses, gauge washers, manhole gaskets, shovels, brooms, boiler compound, etc.; and labor expended, such as fire-room engineer and assistants, water tenders, feed pumpmen, ash handlers, etc., and all other supplies, (except fuel), and labor in connection with the production of steam. Do not include in this account, however, fuel oil, or lampblack expense for fuel.

(2) **Generating Plant:** All material, (except fuel oil), and labor expended in generating gas, from fuel oil or producing water gas. This includes material used, (except fuel oil and lampblack), such as waste, brooms, towels, etc.; and labor expended for gas makers and gas makers assistants.

(3) **Purification Plant:** All material and labor expended in the purification of gas. This includes the average cost of oxide actually used, (the invoice cost and freight, plus shavings, plus labor and cartage necessary to store it, plus the cost of mixing it), and the invoice cost of lime actually used; also labor expended in cleaning and tending apparatus.

(4) **Fuel oil for steam.** All fuel oil used for firing boilers in production of steam. This should include the cost of freight and switching, and labor of unloading.

(5) **Fuel oil for gas:** All fuel oil used in the generators for production of fuel oil gas. This should include the cost of freight and switching, and labor of unloading.

(6) **Lampblack expense for steam:** All labor expended, in wheeling or carting lampblack from sumps to fire-rooms of steam plant, but the labor expended for firemen should not be included.

(7) **Lamblack expense for gas:** All labor expended, in wheeling or carting lampblack from sumps to water gas sets, but this does not include the labor expended for gas makers.

(8) **Lampblack expense removing:** All labor and other expenses in handling lampblack not used for fuel or water gas. This would include carting, wheeling and hauling.

(9) **General labor and supplies:** All material and labor expended, not includible in the foregoing accounts. This would include watchmen, janitors and keeping grounds in order.

(10) **Superintendence:** This should include the cost of labor and personal expenses, but does not include departmental foremen.

(11) **Office Salaries:** All labor expended in keeping operating records, such as timekeepers and clerks.

(12) **Office expense:** All supplies and labor expended in caring for offices and stationery. This should include stationery, (furniture not included in capital), mops, towels, rent, etc.; also labor expended for janitors and watchmen.

(13) **Stable expense:** The cost of running a stable, or boarding horses, where devoted exclusively to Generating Department. This would include cost of supplies such as robes, blankets and whips; labor, such as stable attendants and shoers. If stable supplies horses, for departments generally, charges should be made to account, "General Stable Expense." Stable expense should be proportioned against sub-accounts under generating expense benefited.

(14) **Auto expense:** All material and labor expended in the operation of automobiles, motorcycles and bicycles. This account should include the cost of such material as lubricants, gasoline, etc.; labor expended for chauffeur, washing, polishing, etc., and garage expense.

Transmission Expenses.

Charge to this account the cost of the following subdivisional expenses:

(1) **Boosting apparatus:** All material and labor expended in operating boosting equipment. This includes waste, lubricants, packing, etc., and labor of valvemen, engineers and watchmen.

(2) **Patrolling and inspecting:** All supplies and labor expended in patrolling and inspecting trunk lines. This includes labor of patrolmen and inspectors, livery and personal expenses.

(3) **General labor and supplies:** All material and labor expended, not includible in the foregoing accounts. This would include watchmen, janitors and keeping grounds in order.

(4) **Stable expense:** Cost of running a stable, or boarding horses, where devoted exclusively to Transmission Department. This would include cost of supplies such as robes, blankets and whips, labor, such as stable attendants and shoers. If stable supplies horses, for departments generally, charges should be made to account, "General Stable Expense." Stable expense should be proportioned against sub-accounts under transmission expense benefited.

(5) **Auto expense:** All material and labor expended in the operation of automobiles, motorcycles and bicycles. This account should include the cost of such material as lubricants, gasoline, etc.; also labor expended for chauffeur, washing and polishing, etc., and garage expense.

(6) **Superintendence:** This should include the cost of labor and personal expenses, but does not include departmental foremen.

(7) **Office salaries:** All labor expended in keeping operating records, such as timekeepers and clerks.

(8) **Office expense:** All supplies and labor expended in caring for office and stationery. This should include stationery, (furniture not included in capital), mops, towels and rent; also labor expended for janitors and watchmen.

Distributing Expenses.

Charge to this account the following sub-divisional expenses:

(1) **Sets and outs:** Material and labor expended in setting and removing meters for registering the gas delivered to consumers. This includes livery, material such as caps, sleeves and meter shelves; also labor of metermen, but does not include station meters, nor changing meters on complaint.

(2) **Complaints:** All material used, and labor expended, in attention to complaints of consumers on service rendered. This includes pumping services, testing meters, etc.; also labor of men engaged in this work, but does not include sets and outs occasioned by application for service or discontinuance of service.

(3) **Inspectors**: All labor expended, the supplies furnished inspectors, making general inspections such as checking meters installed against consumers and inspecting connections.

(4) **Statements**: All labor expended, in reading meters registering gas delivered to consumers. This should also include livery, carfare and personal expenses allowed.

(5) **Collectors**: Labor expended, in presenting bills for gas consumed and making connections therefor. This account includes livery, car fare, and personal expenses allowed.

(6) **Setting and removing regulators**: The cost of setting and removing district and house regulators. This should include labor expended and all material except permanent construction, but does not include station or trunk line regulators.

(7) **Municipal street lighting expense**: All material and labor expended in trimming and renewing globes and gas mantles; testing and washing, of all arc lamps; street lamps used for municipal street lighting. This should also include lamps for lighting districts of state and counties. This account should include labor and livery stable expense and all other expenses in connection with street lighting operation, but not the cost of such repairs as necessitate the removal of the lamp from service, nor any expense of commercial arc lighting.

(8) **Trimming commercial arc lamps**: The cost of trimming arcs. This account should include labor expended, in trimming and lighting arc lamps; also such supplies as torches, mantles and globes; but not trimming municipal street lamps.

(9) **Gratuitous service**: All material and labor expended in furnishing free service, such as changing position of meter, adjusting house appliances, and such other work beyond meter. Do not charge to this account, however, the cost of any free service, unless it is the policy of the company to charge for such.

(10) **Free lamp renewals**: All material and labor expended, in free renewals of lamps for consumers. This includes labor of inspectors, salesmen, material, including lamps, globes, etc.; also livery and personal expenses of inspectors and salesmen. This account should include the cost of lamp renewals, where such renewal is in accordance with the rates granted and the schedule enforced, but should not include gratuitous service or donations.

(11) **Donations**: All contributions to charity and public institutions and organizations.

(12) **New business expense**: All advertising contracts, printing posters, hand bills, and labor expended for advertising managers, clerks and solicitors; also all concessions made for securing new business.

(13) **Superintendence**: The cost of all labor expended for general superintendence. This should include livery and stable expense, personal expenses, but not the expense of the departmental foremen.

(14) **Office salaries**: All clerical labor in connection with keeping the records of accounts. This should include bookkeepers, cashiers, timekeepers and stenographers, but not collectors and statement takers.

(15) **Office expense**: All material and labor expended, such as stationery, rent, janitors and supplies, and watchmen.

(16) **Stable expense**: All supplies, labor expended in operating a company stable, or boarding horses. This account should include the cost of hay, grain, water, harness dressing and repairs and shoeing; also labor expended for stable attendants. Charge to this account also all stable supplies and expense for the month, then apportion the expense against each department benefited as shown by stable record.

(17) **Auto expense**: All material and labor expended in the operation of automobiles, motorcycles and bicycles. This account should include the cost of such material as lubricants, gasoline, etc.; also labor expended for chauffeur, washing and polishing, etc., and garage expense.

(18) **General labor and supplies**: All material and labor expended, not includible in the foregoing accounts. This includes watchmen, general labor, etc.

PACIFIC COAST BUSINESS CONDITIONS.

The second month of the year and the early portion of March, says the Pacific Coast Banker, have brought no particularly significant developments to the business situation of the Pacific Coast, and there has been well sustained the general outlook for another year of good crops and general business prosperity. The coast states have fully shared the sustained improvement of trade that has marked the country as a whole, and also the country's general feeling of either satisfaction or resignation at the change of administration, the sentiment depending upon the political point of view of the business man, but without any noteworthy effect on business conditions.

The feature of the business outlook in California during the latter part of February and the early portion of March was mainly concerned with the question of rain. The amount of rainfall in the state had been somewhat less than normal and the farmers of the interior valleys and the business men of the interior cities and the larger wholesale centers had taken on something of a feeling of discouragement. Very recently a general rainfall, however, has dispelled whatever pessimism had arisen, and California's outlook for the coming year has resumed its encouraging features. There is now abundant snow in the mountains, which is a vital factor in the prosperity of the interior of the state, through the necessity of a summer supply of water for irrigation, power and mining. This is now assured, and the ground has received a good wetting, which assures normal conditions for horticultural and agricultural crops. California has not before in its history seen such a measure of development throughout its length and breadth or such confidence in an early marked increase in the volume of its colonist business.

Railroad and other authorities concerned with eastern immigration predict that the coming month will see a very large influx of both tourists and colonists to all the coast states. In the northwest, conditions have undergone but little change in the last few weeks. The basic lumber industry maintains its prosperous condition.

THE PRACTICAL APPLICATION OF THE SELF-ADJUSTING STANDARD FOR RATE FIXING.

BY F. K. BLUE.

A self-adjusting method of rate fixing which would provide for establishing rates and prices for government regulated corporations according to predetermined rules instead of adjusting them according to the discretion of the rate fixing bodies was suggested in this journal for November 28 and December 7. This method provides an exact adjustment of the relations between the corporation and the consumer according to well established economic principles in place of the arbitrary and erratic adjustment that only is possible at best when the rates are determined by guess work from a yearly appraisal of values according to the best judgment of rate fixing bodies.

The pre-eminently important and far-reaching results of this method are accomplished by three very simple expedients.

1. The fundamental principle of the method is that the price of the product of an enterprise in one year is based on the market price of the stock in such enterprise during the preceding year.

2. As a protection to the consumer against excessive cost of production due to extravagant management, adjustments are made which cause a gain to stockholders whenever the cost of production is reduced and a loss when the cost of production is increased.

3. All surpluses and deficits due to the yearly rates that are fixed proving too great or too small are exactly adjusted by a system of perpetual amortization of such quantities between the corporation and the consumer.

To carry out the first principle a record is kept of the amount of the investment, the yearly quantity of product sold, the operating cost of production of such product, and the average market price of the stock of the company. Then the required rate of interest on the investment, as indicated by the ratio between the required earnings and the market value of the stock in a given year, is applied to the amount of the actual investment for the succeeding year. This amount added to the estimated cost of operation for the year and then divided by the estimated quantity sold during the year determines the estimated price required for the product during the year. Thus a higher stock valuation would show a smaller profit to be acceptable to the investors and so establish a lower price for the succeeding year, and vice versa.

The second principle is carried out by basing the gain or loss to be amortized and the required earnings which determines the price for the succeeding year on a cost of operation commensurate with the actual cost of operation of previous years instead of taking the actual cost for the given year.

The third principle is carried out by estimating the surplus or deficit caused by the price fixed for the year proving too great or too small, and subtracting a certain part of the accumulated surplus so caused from the estimated earnings by which the price in the succeeding year is fixed, or, in case of a deficit, adding a part of the deficit to such earnings.

The chief result that would be secured if these methods were carried out would be that consumers would have to pay for products produced under conditions of monopoly no more than is required under conditions of normal competition. In fact monopoly would be established on the economic basis of competition without incurring the risk of loss of business to competitors and the evils of "cut-throat competition."

Consumers would be protected against excessive prices, but the corporation would at the same time be protected against inadequate prices that might otherwise be fixed by an unfriendly commission or an initiative vote since the price would be automatically adjusted to just include cost of operation and replacement and the return on investment which the public is willing to accept as shown by the price paid for stock in the enterprise.

Since a fictitious valuation of stock would be impossible the consumer would never be called upon to pay a profit on a capitalization not represented by an actual investment of cash, and a future purchaser of stock would not run the risk of paying prices for it that were based on promises of earnings that were not likely to be realized. Since all valuation of stock would be automatically based on actual cash invested, its speculative character would be reduced practically to the level of well-secured bonds.

The return on the original investment would at all times be held to the amount that prospective purchasers of stock would be willing to receive for their money at the time of purchase. The consumer would then pay at all times as a return on the investment just what the public by its willingness to invest decides that it is worth, thus exactly adjusting the relations between the stockholders and the consumers in a way that neither party could have any valid ground for complaint or criticism.

There being no fictitious valuation of the stock a purchaser would have a reasonable assurance of the return of his investment if during its life it yielded sufficient surplus return to provide for depreciation.

Since the method and rules for computing all prices and values would be definitely predetermined by the terms of the franchise, expensive litigation between the public and the corporation would be avoided because all such prices and values being at all times definitely established by the franchise, there would, except for violation of contract, be nothing of importance to adjudicate.

Trusts conducted according to this method would not need to be dissolved but should be strengthened instead, since they could then often serve the consumer at lower prices than smaller independent organizations..

Condemnation proceedings for the acquisition of utilities by the public would be simplified because their valuation would be already established by the prices quoted in the public market which then should be taken as a measure of the value of the property.

Practical Illustration of the Working of the Method.

To demonstrate that this method will work out as stated, the following table has been prepared to show its application to such a public utility as a gas company during a period of years in which the busi-

EXAMPLE OF COMPUTATIONS FOR SELF-ADJUSTING RATE FIXING METHOD

	given	$r^\circ i$	$\frac{1}{2}S^\circ$	$d-G$	$\phi(q)$	$\phi(u)$	UQ	$D+C$	$\frac{E}{Q}$	P or p°	given	pq	given	$\frac{c}{q}$	given	$\frac{d}{v}$	ri	Uq	$d'+C'$	$e-E'$	$\Sigma G'$	$d'+c$	$e-e'$	$\Sigma g'$	$\frac{e'}{q}$
Year	i	d	G	D	Q	U	C	E	P	p	q	e	c	u	v	r	d'	C'	E'	G'	S'	e'	g'	s'	p'
																.06									
1	200	12								1.35	22	29.7	40	1.82	200	.06	12					52.0	-22.3	-22.3	2.36
2	200	12								1.35	29	39.2	41	1.42	200	.06	12					53.0	-13.8	-36.1	1.83
3	200	12								1.35	40	54.0	47	1.18	200	.06	12					59.0	- 5.0	-41.1	1.47
4	200	12								1.35	50	67.5	48	.96	200	.06	12					60.0	+ 7.5	-33.6	1.20
5	200	12	- 2.1	14.1	49.5	.92	45.5	59.6	1.21	1.21	54	65.3	50	.93	200	.06	12	49.7	61.7	+3.6	-30.0	62.0	+3.3	-30.3	1.15
6	200	12	- 4.2	16.2	56.0	.87	48.5	64.7	1.16	1.16	52	60.3	48	.92	190	.063	12.6	45.1	57.7	+2.6	-27.4	60.6	- 3	-30.6	1.16
7	200	12.6	- 6.3	18.9	55.0	.88	48.3	67.2	1.22	1.16	55	63.8	52	.95	190	.066	13.3	48.3	61.6	+2.2	-25.2	65.3	- 1.5	-32.1	1.19
8	200	13.3	- 8.4	11.7	54.7	.93	51.0	62.7	1.15	1.15	60	69.0	54	.90	210	.063	12.6	55.9	68.5	+ .5	-24.7	66.6	+2.4	-29.7	1.11
9	200	12.6	-10.5	23.1	58.4	.92	53.4	76.5	1.31	1.15	63	72.5	55	.87	200	.063	12.6	57.7	70.3	+2.2	-22.5	67.6	+4.9	-24.8	1.07
10	200	12.6	-11.5	23.8	63.2	.88	55.7	79.5	1.26	1.15	62	71.4	54	.87	200	.063	12.6	54.7	67.3	+4.1	-18.4	66.6	+4.8	-20.8	1.07
11	200	12.6	- 9.2	21.8	63.6	.86	54.7	76.5	1.20	1.15	64	73.6	55	.86	200	.063	12.6	55.1	67.7	+5.9	-12.5	67.6	+6.0	-14.0	1.06
12	200	12.6	- 6.2	18.8	63.9	.86	54.9	73.7	1.15	1.15	63	72.5	56	.89	200	.063	12.6	54.1	66.7	+5.8	- 6.7	68.6	+3.9	-10.1	1.09
13	200	12.6	- 3.4	16.0	63.3	.88	55.7	71.7	1.13	1.13	62	70.7	53	.86	200	.063	12.6	54.5	67.1	+3.6	- 3.1	65.6	+5.1	- 5.0	1.06
14	200	12.6	- 1.6	14.2	62.6	.87	54.2	68.4	1.09	1.09	63	68.7	53	.84	200	.063	12.6	54.5	67.1	+ 1.6	- 1.5	65.6	+3.1	- 1.9	1.04
15	200	12.6	- .8	13.4	62.4	.85	52.9	66.3	1.06	1.06	63	66.8	55	.87	200	.063	12.6	53.4	66.0	+ .8	- .7	67.6	- .8	- 2.7	1.07
16	200	12.6	- .4	13.0	62.9	.86	53.8	66.8	1.06	1.06	63	66.8	52	.83	210	.06	12.	53.9	65.9	+ .9	+ .2	64.0	+2.8	+ .1	1.02
17	200	12	+ .1	11.9	63.2	.84	53.2	65.1	1.03	1.03	58	59.7	52	.90	210	.057	11.4	48.8	60.2	- .5	- .3	63.4	-3.7	-3.6	1.09
18	200	11.4	- .2	11.6	59.5	.88	52.2	63.8	1.07	1.07	54	57.8	50	.93	200	.057	11.4	47.3	58.7	- .9	- 1.2	61.4	-3.6	- 7.2	1.14
19	200	11.4	- .6	12.0	54.7	.92	50.1	62.1	1.14	1.14	60	68.5	54	.90	190	.06	12	54.8	66.8	+1.7	+ .5	66.0	+2.5	-4.7	1.10
20	200	12	+ .2	11.8	56.8	.92	52.5	64.3	1.13	1.13	64	72.3	54	.84	200	.06	12	59.2	71.2	+ 1.1	+1.6	66.0	+6.3	+1.6	1.03
21	200	12	+ .8	11.2	62.6	.86	54.1	65.3	1.04	1.04	64	66.5	53	.83	190	.063	12.6	55.3	67.9	- 1.4	+ .2	65.6	+ .9	+2.5	1.02
22	200	12.6	+ .1	12.5	65.6	.82	53.9	66.4	1.01	1.04	63	65.5	50	.79	190	.066	13.3	51.8	65.1	+ .4	+ .6	63.3	+2.2	+4.7	1.00
23	200	13.3	+ .3	13.0	64.1	.79	50.7	63.7	.99	.99	64	63.4	52	.81	190	.07	14	50.6	64.6	- 1.2	- 6	66.0	-2.6	+2.1	1.03
24	200	14	- .3	14.3	63.6	.80	50.9	65.2	1.02	1.02	63	64.3	48	.76	200	.07	14	50.4	64.4	- .1	- 7	62.0	+2.3	+4.4	.98
25	200	14	- .4	14.4	63.2	.77	48.8	63.2	1.00	1.02	60	61.2	48	.80	190	.074	14.7	46.3	61.0	+ .2	- 5	62.7	- 1.5	+2.9	1.04
26	200	14.7	- .2	14.9	61.0	.79	48.1	63.0	1.03	1.02	55	56.1	48	.87	190	.078	15.5	43.3	58.8	-2.7	-3.2	63.5	-7.4	-4.5	1.06
27	200	15.5	- 1.6	17.1	56.0	.84	47.3	64.4	1.15	1.15	50	57.5	48	.96	200	.078	15.5	42.3	57.8	- .3	-3.5	63.5	- 6.0	-10.5	1.27
28	200	15.5	- 1.8	17.3	50.4	.95	47.8	65.1	1.29	1.29	50	64.5	50	1.00	200	.078	15.5	47.5	63.0	+ 1.5	-2.0	65.5	- 1.0	-11.5	1.31
29	200	15.5	- 1.0	16.5	48.5	1.01	49.0	65.5	1.35	1.29	48	61.9	50	1.04	210	.074	14.7	48.6	63.3	- 1.4	-3.4	64.7	-2.8	-14.3	1.35
30	200	14.7	- 1.7	16.4	47.6	1.05	48.9	65.3	1.37	1.37	45	61.7	47	1.04	210	.07	14	47.3	61.3	+ .4	-3.0	61.0	+ 7	-13.6	1.36
31	200	14.	- 1.5	15.5	45.7	1.05	48.2	63.7	-1.39	1.37	42	57.6	45	1.06	200	.07	14	44.3	58.3	- .7	-3.7	59.0	- 1.4	-15.0	1.40
32	200	14	- 6.8	15.8	42.2	1.06	44.9	60.7	1.44	1.44	36	51.8	44	1.22	200	.07	14	38.3	52.3	- .5	-4.2	58.0	- 6.2	-21.2	1.61
33	200	14	-2.1	16.1	36.9	1.10	40.5	56.6	1.53	1.53															

Quantity of gas, in million cubic feet. Unit costs and prices, in dollars per thousand cubic feet. Other items in thousands of dollars.

ness is built up and begins to decline and in which there are severe fluctuations in the quantity sold and in the cost of operation. The only given quantities required by this method after the first year are the amount of the investment, the quantity sold each year, the cost of operation, and the average market price of the stock, all of which is simply a matter of record. All other items are computed according to predetermined rules in which there is no judgment necessary or discretion allowed in their application. The rate fixing power therefore would not be open to charges of either favoritism or injustice, since its function is simply to ascertain items of record and actual fact and from these data to compute the rates according to the predetermined rules.

The terms used in this description will first be tabulated and defined, and then each step in the application of the method will be explained consecutively and in detail.

Quantities Defined—Actual Quantities Given.

i = total amount of the investment—assumed to be $200,000 in a system for the production and distribution of gas.

q = total quantity of gas sold, in thousand cu. ft. per year.

c = total operating cost of producing gas during the year.

v = average market value of outstanding common stock during the year.

Quantities Computed from Actual Given Quantities.

r° = required rate of interest of investment as indicated by the market value of the common stock during the preceding year.

$d = r^\circ \times i$ = required net earnings on investment as indicated by the market price of the common stock during the preceding year.

$p = P$ or p° = actual price paid for the gas during the year, per thousand cu. ft.

$e = p \times q$ = actual gross earnings received during the year.

$u = c \div q$ = actual unit operating cost of producing gas during the year, per thousand cu. ft.

$r = d \div v$ = required rate of interest on investment as indicated by the market value of the stock during the given year.

$d' = r \times i$ = required net earnings on the investment as indicated by the market value of the common stock during the given year.

Estimated Quantities.

$G = \frac{1}{2} S^\circ$ (after the payment of one-half the deferred dividends) = estimated gain, or loss, to be amortized during the year.

$D = d - G$ = estimated required earnings exceeding cost of operation.

Q = assumed quantity of gas to be sold during the year, estimated from the actual quantities sold during previous years.

U = assumed unit operating cost of producing gas during the year, estimated from the actual unit operating cost during previous years.

$C = U \times Q$ = assumed operating cost of producing gas during the year.

$E = D + C$ = estimated gross earnings required during the year.

$P = E \div Q$ = estimated required price of gas for the year.

Quantities Adjusted to Cost of Production Commensurate With Actual Cost in Previous Years.

$C' = U \times q$ = total operating cost of producing gas during the year commensurate with the actual operating cost in previous years.

$E' = d' + C'$ = adjusted gross earnings required during the year to pay cost of production and required dividends on the stock.

$G' = e - E'$ = adjusted gain, or loss—being the excess, or deficiency, of actual over adjusted required earnings for the year.

$S' = \Sigma G'$ = the adjusted accumulated surplus, or deficit, during the life of the investment up to the end of the year.

S° = the adjusted accumulated surplus, or deficit, during the life of the investment up to the end of the preceding year.

Actual Quantities Indicated by the Market Value of the Stock.

$e' = d' + c$ = gross earnings required during the year to pay the cost of operation and earnings required on the investment, as indicated by the market price of the stock during the year.

$g' = e - e'$ = gain, or loss—being the excess, or deficiency, of the actual over the required gross earnings for the year.

$s' = \Sigma g'$ = accumulated surplus, or deficit, during the life of the investment up to the end of the year.

$p' = e' \div p$ = price which would be required in order to just pay the earnings required on the investment and the operating costs for the year, as indicated by the market value of the stock during the year.

Explanation of Table.

An investment, i, of $200,000 is assumed to be paid in cash into the corporation treasury for the purchase of a gas service system, which is then represented by the whole quantity of outstanding stock that is issued. At an acceptable dividend rate, r°, of 6 per cent, assumed to have been stated in the bid for the franchise, the estimated amount of the dividend required for the first year will be $d = r^\circ i =$ $12,000

Until the earnings have become greater than the operating cost plus the required return on the investment, the price of the gas is fixed at an arbitrary amount that will be likely to provide for the payment of the deferred dividends within a reasonable time. In the example, ten years is the estimated allowance for the deferred dividends to be paid up, and six years for the quantity sold to reach sixty million cu. ft. per year. Under these conditions the average price during this period is estimated at $1.35 per thousand cu. ft.

At this price, 2,000,000 cu. ft., the quantity, q, assumed to be sold during the first year, will yield a gross income $e = pq =$ $29,700.

The total operating cost of production of gas during the year as assumed to be $c =$ $40,000. This should cover all operating costs as shown by the records, but should not include anything of the nature of interest on bonds, dividends on preferred stock, or sums set aside in depreciation or amortization funds.

The unit cost of operation for the year is this cost divided by the quantity of gas sold during the year, which will be $u = c \div q =$ $1.82 per thousand cu. ft.

If the average market value of the outstanding common stock, v, during the year, is $200,000, then the estimated required dividend, d, divided by this value shows the required dividend rate for the year to be $r = d \div v = 0.06$, or 6 per cent.

The product of the required dividend rate, r, by the value of the investment for the year, i, will show the actual required dividend for the year as indicated by the market value of the stock to be $d' = ri =$ $12,000.

This indicated dividend added to the actual cost of operation will show the indicated gross earnings required for the year to be $e' = d' + c =$ $52,000. This amount should also include interest on bonds, dividends on preferred stock, and the amount set aside in the depreciation fund during the year. In the adjustment of the depreciation fund, appreciation and depreciation of both equipment and real estate should be taken into account and the fund kept at such a figure that the physical value of the property, plus the depreciation fund would at all times be just equal to the value of the invest-

ment. The depreciation fund is of the same economic nature as the surplus, S′, so that whenever the depreciation fund is too large the excess can be transferred to the surplus account and, vice versa, when it is too small it can be replenished from the surplus account. Large transfers either way should be made gradually, however, so that there may be no violent fluctuations in price. In practice, adjustments would of course be made for interest on deferred dividends and surpluses but this adjustment has been omitted in the illustration to avoid unnecessary computations.

The difference between the actual gross earnings, e, and the indicated required earnings, e′, shows the actual gain, g′, to the stockholders over the amount of the required profit which is indicated by the market value of the stock. This will be smaller or larger than the estimated gain, G′, according to whether the cost of production is becoming less or greater. In the first year this gain is negative since there is a large deficit in the actual earnings during the period in which the business is being established. We have then $g' = e - e' = -\$22{,}300$ for the first year.

The accumulated surplus, s′, indicated by the market price of the stock, is found by adding consecutively the gains, g′, for each year.

The required price of the gas as indicated by the market price of the stock is shown by dividing the indicated gross earnings, e′, by the quantity of gas sold, q, giving for the first year, $p' = e' \div q = \$2.36$ per thousand cu ft.

In estimating the dividend required for any year, the dividend rate for the first year preceding will be denoted by r°. So for the second year we will have as before $d = r^\circ i = \$12{,}000$.

These computations are continued in the same manner as explained for the first year and the price of $1.35 per thousand cu. ft. is retained until the gain g′ becomes a positive quantity. In the example this happens in the fourth year, when g′ is found to be $+\$7{,}500$. The corresponding surplus for this year is $s' = -\$33{,}600$, which being a negative quantity, shows that it is a deficit that must be paid to the stockholders as deferred dividends. This payment should be distributed over several years in a way that will cause as little fluctuation in price as possible. The exact method of this distribution will make little difference in the end but the period of distribution should be of sufficient extent that the burden does not fall unduly upon the early consumers. The method followed in the illustration is to estimate, for the first year in which the normal method of rate fixing is established, the amount of deferred dividends to be paid at $G = s' \div n^2$, in which s′ is the accumulated deficit, and n is the number of years during which this deficit has accumulated. Twice this amount is then taken for the next year, three times the amount for the third year, and so on until the quantity so computed is numerically greater than ½ S′, the estimated deficit for the preceding year. When this point is reached, and thereafter, G the estimated gain, or loss, to be amortized in any given year may be taken equal to one-half of S′, the estimated accumulated surplus, or deficit, for the preceding year. In the illustration, for the fifth year $G = -\$33{,}600 \div 4^2 = -\$2{,}100$. In the sixth, seventh, eighth and ninth years G is two, three, four and five times this amount, or —$4,200, —$6,300, —$8,400, and —$10,500 respectively. In the tenth year G, computed by this method, would be —$12,600, but as this is numerically greater than —$11,200, the half of S′ for the preceding year, G for the tenth year and thereafter is taken equal to one-half the value of S′ for the preceding year.

In the fifth year the estimated net earnings required to be provided for in fixing the price of gas for the year, D, is equal to d, the required net earnings on the investment as indicated by the market value of the stock during the preceding year, less G, the estimated gain, or loss, to be amortized during the year. Since G is a negative quantity this year—representing a loss—the value of D is the numerical sum of the required net earnings, $d = \$12{,}000$, and the loss, $G = -\$2{,}100$, which amounts to $14,100.

(To be continued)

SELECTION OF EXPLOSIVES.

The United States Bureau of Mines has just published Bulletin 48, The Selection of Explosives Used in Engineering and Mining Operations, by Clarence Hall and Spencer P. Howell. It deals with the characteristic features of the principal explosives used in engineering and mining operations, and especially with the tests that show the suitability of different classes of explosives for various kinds of work.

Black blasting powder is stated to be best suited for work in which a gradual pushing or heaving effect is desired, such as excavating cuts, quarrying soft rock or stone, and especially in quarries where large blocks of building stone are sought, and in order to obtain the maximum efficiency the charge must be well confined by suitable stemming. Granulated nitro-glycerin powder is more effective and gives better results than black blasting powder in soft and seamy rock or in material that does not sufficiently confine the gases evolved. "Straight" nitro-glycerin dynamites, as a class, develop greater disruptive force than any of the other commercial classes of explosives tested, and for this reason they should be used for producing shattering effects or for blasting very tough or hard materials whenever the conditions permit. If the "straight" nitro-glycerin dynamites are found to be too violent for certain classes of work, the low-freezing dynamites or the ammonia dynamites, which have lower rates of detonation and hence less disruptive effect, are recommended. The low-freezing dynamites have the advantage of not freezing until exposed to a temperature of 35 degrees F. or less, but, like all nitro-glycerin explosives, after they become frozen they must be thawed before use in order in insure the most effective results. As the ammonium nitrate used in ammonia dynamite is deliquescent, this class of explosive absorbs moisture more readily than other dynamites, therefore it is emphasized that care should be observed when storing this class of explosives in wet or damp places. The gelatin dynamites have been used to a large extent in wet blasting, such as in the removal of obstacles to navigation and in deep workings, and, as a general rule, they are best suited for these purposes.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Recent San Francisco Elections

It is a source of satisfaction to all well-wishers of the West to note the overwhelming manner in which the voters of San Francisco have ratified the recent compromise proposal of the Mayor and the United Railroads of that city, looking toward a final adjustment of the years of litigation on lower Market street. The old horse car, so long utilized to hold franchise status, will be done away with, and undoubtedly the traffic congestion of the Exposition city will adjust itself by leaps and bounds. An era of natural understanding and helpfulness on the part of all parties to the issue will now unquestionably follow. Once again the city by the Golden Gate has made good, for San Francisco knows how.

Windage Losses

In the early days of engineering evolution many were prone to state that the beautiful applications of the calculus must end at the class room door and that its sole excuse for a useful existence must ever be limited to elucidating the principles and not the applications of engineering mechanics. In a word the instant the student left his theoretical studies to engage in the practical pursuits of his chosen profession he should tenderly lay aside his mathematical deductions and to all theories of academic development say "good night."

Not so cruel, however, has the recent trend of engineering affairs shaped itself. Electrical engineering, by its astonishing advance, has awakened the eyes of the world to the triumph of intricate mathematical formulas in predicting phenomena and explaining the hidden mysteries of this interesting branch of applied science.

Recent advances, too, strongly emphasize the applications of calculus or infinitesimal quantities, even though it is impossible to find the actual algebraic equation to represent the experimental data.

Peabody, for instance, compiled his latest steam tables on entropy and other important data by actually plotting specific heats degree by degree and thereby graphically, but accurately integrating to obtain the heat of liquid since the exact mathematical expression for performing this operation has never yet been discovered.

Again, something over a year ago new experiments on the increase of wind pressure upon small wires were published in the columns of this journal. Deceleration curves, or curves showing the ratio of decrease in speed over a small period of time were utilized in getting the data for certain constants of the wires. In this issue of the Journal may be found more data along the same lines showing how the slippage and windage losses of any rotating mechanism may be obtained. Such factors may be obtained by an observer closing a chronograph circuit at the instant a tachometer needle indicates even hundreds of revolutions per minute decrease when the mechanism after set spinning, is free to slow down, due to its own friction and windage impediments.

Such a method, giving as it does a simple yet accurate process whereby friction and windage losses are easily obtained, may well be put into use in Western power plants, where in the past too little data concerning such losses have been amassed.

Electricity in the Oil Fields

In the days of old John Corliss the engineering world was treated to a genuine surprise by having solicitors sign up for orders for engines equipped with the Corliss valve in which the only pay asked was to be taken from the savings to be acquired by using the improved apparatus. During the past year the hydroelectric fraternity in the West has in many instances been able to reduplicate this feat by installing electric motors where other forms of driving mechanisms were being used.

The most striking instance of the onslaught of this nature that may at times ensue is that of the utilization of the electric drive in the oil fields. Oil production in California has during the past decade assumed gigantic proportions. Last year its 87,000,000 bbls. of crude petroleum placed that commonwealth in the foremost rank of oil producing sections of the world. The remarkable feature of it all is that while the output in the old world, notably in southeastern Europe, is beginning to wane, California has not yet reached the zenith of her glory in this regard.

Up to July, 1910, no oil producer was so bold as to openly state that electricity would ever invade a district teeming in itself in energy-producing matter. Indeed it took eighteen months from this date before the first installation, so interestingly described on another page of this issue, proved conclusively the superiority of electrically-driven apparatus in the oil fields. Since January first 1912, then the era of the supremacy of electricity in the oil fields may consistently be dated. In the lower San Joaquin valley of California 39 oil companies attest their faith in electricity by having 669 of their wells electrically operated. The future, too, is bright, for conservatively speaking 1200 additional motors, exclusive of drilling, compressor, field pump and other forms of electrical drive are anticipated for the coming season. This lightning campaign has been materially aided by the firm confidence displayed on the part of the manufacturers of electrical apparatus who have sold their product in countless instances upon the basis of receiving their pay from the savings effected by electrically operated drives in the oil fields. A change over from one form of power to another that may be liquidated in ten months' time is indeed an evolution in efficiency deserving of encouragement from every quarter. That electricity should be the on-slaying giant is another source of confidence in its bright future on the Pacific Coast.

This new field of utilizaton of hydroelectric power is, considered again from another viewpoint, a source for rejoicing by all those who worship true conservation. For here in this self-same state so productive in energy-giving petroleum the resourceful and non-diminishing waterfall is harnessed for eternity in order that the latent force of the oil may be delivered to other communities not so fortunate in natural blessings.

The High Cost of Cost Keeping

In the early days of commission regulation it was found that the methods of accounting which were used by the various utility companies were so incomplete and often times so varied in methods adopted that a consistent treatment of rate-fixing was impossible without the institution of the most painstaking inventories and new methods of uniform accounting.

No one will deny the wisdom of such a move as this. It has had a far-reaching effect in stabilizing the status of utility securities and in winning the confidence of the reasonable public. In former days, too, the public was not given the information their right to know and indeed in response to a courteous inquiry often received a reply that could be characterized as anything but civil. The evasive answer, however, proved the most trying. As an excuse for their sins the utility executives would often apply the methods of father Adam, "the woman gave me of the tree and I did eat," or of mother Eve, "the serpent beguiled me and I did eat," or as is technically described in modern parlance these early executives would diplomatically endeavor to play the great American game, "passing the buck."

A wholesome, sane appreciation of each other's rights has, however come over utility executives and the reasonable public. Such being the case, is it not questionable whether the enormous outlays of money necessitated in the intricate and elaborate systems of accounting are not themselves contributing to the high cost of the necessities of life. Literally carloads of cost data are now being accumulated, covering the great utility companies of the West, wherever commission regulation has been in operation for some time past.

It is to the credit of the hydroelectric companies of the West that the commissions in many instances have seen fit to adopt almost in its entirety the systems of accounting used by its leading companies. Such for instance was the case for utility accounting under commission regulation which is concluded elsewhere in this issue.

We all stand aghast, nevertheless, when we realize that the actual cost involved in detailing and segregating the various systems of accounting under the present system in California entails an outlay of fifteen per cent of the gross annual expenditures of the utility company.

It is not argued that detailed inventories and accounting should be abandoned. But it is urged, however, since modern utility operation and regulation necessitate enormous outlays of money that every reasonable economy possible should be instituted in seeing that the cost of cost-keeping be kept within the same reasonable bounds that regulation attempts to accomplish in the fixing of rates; namely, that further detail attempts in accounting cease when the interest on the money to be saved thereby is not sufficient to pay the additional expenses involved.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. E. Grant, sales engineer with the Holophane Works, is at Vancouver, B. C.

J. C. Berger, manager of the Denver Gas and Electric Company, is at San Francisco.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, is at Los Angeles.

J. O. Presbrey of the Holophane works of the General Electric Company is at San Francisco.

H. W. Beecher, manager of the Seattle office of Chas. C. Moore & Company, is at New York City.

Geo. M. Mills has been appointed manager for the Goldfield district of the Nevada-California Power Company.

A. L. Rohrer, electrical superintendent at the Schenectady Works of the General Electric Company, is at San Francisco.

M. Allen, telephone sales manager of the Northern Electric Manufacturing Company, Montreal, was in Seattle, recently.

Wm. G. McKenny, manager of Eccles & Smith Company at Portland, has been chosen as Jovian Statesman for the ensuing year at Portland.

G. I. Kinney, Pacific Coast manager for the Fort Wayne Electric Works and the Sprague Electric Works of the General Electric Company is at Seattle.

J. F. NePage, of NePage, McKenny & Company, electrical contractors and engineers, Seattle, has been in Portland for 10 days looking after contracts of the firm.

J. G. De Remer, chief engineer for the United Light & Power Company, has returned to his San Francisco offices from a trip throughout Washington and British Columbia.

W. A. Layman, president and general manager of the Wagner Electric Manufacturing Company of St. Louis, has been elected president of the National Metal Trades Association.

M. F. Steel, representative of the Benjamin Electric Manufacturing Company, has returned to San Francisco from an extended trip throughout Oregon, Washington, Idaho and Utah.

E. B. Strong, president and general manager of this Journal, is at Seattle to arrange Northwest participation in the trip to the N. E. L. A. convention on the Golden Poppy Special No. 2.

O. H. Ensign, chief electrical engineer, United States Reclamation Service, gave an address before the members of the Electrical League of Southern California, at Los Angeles, on April 22, regarding "Power Development and the Reclamation Service."

Henry M. Jones, who for three years has been in charge of the Lewiston, Idaho, gas plant, has resigned his position, to take effect May 15. The plant is the property of the Pacific Light & Power Company. Mr. Jones has been with the company six years, having served it three years in Oregon prior to taking charge of the plant at Lewiston.

O. W. Rautenberg has taken charge of the office of the Northwestern Supply Company and the Pacific Lamp & Supply Company at 707 Commerce street, Tacoma, succeeding **B. W. Collins**, who was recently made superintendent of electric works for the city. Mr. Rautenberg was formerly in business at Puyallup, Washington, as the Puyallup Electric Supply Company.

OBITUARY.

Monroe Markham, salesman with the Western Electric Company at San Francisco, died in that city on April 17th, following an operation. He was buried under the auspices of the Masons on April 23rd. Mr. Markham was born in Illinois in 1859 and during his connection with the electrical business earned the love and respect of all with whom he came in contact. He is survived by a son and a brother.

MEETING NOTICES.

Los Angeles Section A. I. E. E.

At the regular meeting of the Los Angeles Section of the American Institute of Electrical Engineers on April 22. Mr. Lee Hagood presented a paper on "Transmission Lines and Synchronous Condensers."

Oregon Technical Club.

Prof. Peck of the Oregon Agricultural College addressed the club at the meeting of April 17th regarding the "Artistic Setting of Ordinary Everyday Commercial Necessities." Mr. Crawford urged the co-operation of all the members of the Technical Club, in aiding the movement for the fostering of "Higher Education."

Electrical Development and Jovian League.

The weekly luncheon was held Tuesday last. The by-laws were amended so as to provide for a legislative committee in addition to the other standing committees of the League. The address of the day on "The Aid of American Research to the American Electrical Industry" was delivered by Mr. E. O. Shreve of the General Electric Company.

Tacoma Electrical Contractors' Luncheon Club.

The Tacoma Electrical Contractors' Luncheon Club has been formed. R. C. Hull of Davis & Hull is president and C. A. Young of the Electrical Construction Company, secretary-treasurer. Luncheon is given each Friday. The club has for its objects the promotion of good will among its members and the discussion of matters that may have a bearing upon the welfare of those belonging to it.

Portland Section, A. I. E. E.

At the regular April meeting of the Portland Section of the A. I. E. E. the by-laws were amended, changing the meeting night from the third Tuesday of each month to the first Tuesday after the first Monday of each month—except the months of July, August and September. Hereafter joint meetings will be held with the local sections of the N. E. L. A. The following nominating committee was appointed: Messrs. Lebenbaum, Haynes and Le Tourneau. The annual banquet and election of officers will take place the evening of May 20th.

Tacoma Jovian League.

On May 1st the Tacoma Jovian League will entertain the architects of that city at luncheon. At this luncheon the report and recommendations of a committee selected by the Jovians will be presented to the architects. This committee was delegated some time ago to look into wiring specifications prepared by architects in the past and through a study of these to formulate a list of model specifications. These the Jovians will ask the architects to adopt with a view to improving the standard of wiring. This committee is composed of one electrical contractor, one electrical engineer, one electrical jobber and and one official from the city inspection department.

Portland Jovian Luncheon Club.

The regular Jovian Luncheon Club had a record breaking meeting at the Commercial Club, Thursday noon.

The speaker of the day was Mr. F. T. Griffith, president-elect of the Portland Railway, Light & Power Company. Mr. Griffith spoke on the duty of every man to thoroughly ac-

quaint himself with all legislative matters and he said that the citizens of Oregon were now duty bound to take a deeper interest in political questions, as they must now be the teachers of the women voters of the state. It is now up to them to teach their wives, sisters and sweetheart how to pick the grain from the chaff and help them to become equipped to pick out the demagogues who were bound to arise in our new political system.

Besides the regular speaker of the day Messrs. W. W. Cotton, general attorney Oregon-Washington Railroad & Navigation Company, and B. S. Josselyn, retiring president of the Portland Railway, Light & Power Company, both made short talks.

Wm. F. McKenney, manager of Eccles & Smith Company, Portland, Oregon, was chosen as the new Statesman for the ensuing year. L. W. Sherman of the commercial department of the Northwestern Electric Company, was chosen as the new member on the executive committee.

Eugene Brookings, president of the Progressive Business Men's Club, invited the Jovian Luncheon Club to hold a joint meeting with them next Thursday at the Multnomah Hotel. This invitation was accepted by a unanimous vote. The speaker at this luncheon will be Mayor W. J. Hindley of Spokane, Wash., and his subject will be "Commission Government." Mr. Brookings thought that the club would be more interested in hearing the talk from Mr. Hindley on "Commission Government" than from himself, as Spokane was now using this system.

A. I. E. E. DIRECTORS SUED.

A summons and complaint has been filed in the Supreme Court of New York State by Louis Duncan, Francis B. Crocker and Michael I. Pupin to enjoin and restrain the board of directors of the American Institute of Engineers from transferring or electing members to the grade of Fellow or Member in accordance with the recently adopted special provisions of the constitution of the Institute. This action is also intended to apply to those who have already been transferred. Its effect is to nullify the change in membership status as far as the special section is concerned.

INTERNATIONAL ENGINEERING CONGRESS IN 1915.

In connection with the Panama-Pacific International Exposition, which will be held in San Francisco in 1915, there will be an International Engineering Congress, in which engineers throughout the world will be invited to participate. The congress is to be conducted under the auspices of the five National Engineering Societies, namely: the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers.

These societies, acting in co-operation, have appointed a permanent committee of management, consisting of the presidents and secretaries of each of these societies, and eighteen members resident in San Francisco.

As thus officially constituted, the personnel of the board is as follows:

Representing the American Society of Civil Engineers—Geo. S. Swain, president; Chas. Warren Hunt, secretary; Arthur L. Adams, W. A. Cattell, Chas. Derleth Jr., Chas. D. Marx.

Representing the American Society of Mechanical Engineers—W. F. M. Goss, president; Calvin W. Rice, secretary; W. F. Durand, R. S. Moore, T. W. Ransom, C. R. Weymouth.

Representing the American Institute of Mining Engineers—Charles F. Rand, president; Bradley Stoughton, secretary; H. F. Bain, Edw. H. Benjamin, Newton Cleaveland, Wm. S. Noyes.

Representing the American Institute of Electrical Engineers—Ralph Davenport Mershon, president; F. L. Hutchinson, secretary; J. G. De Remer, A. M. Hunt.

Representing the Society of Naval Architects and Marine Engineers—Robert M. Thompson, president; D. H. Cox, secretary; Geo. W. Dickie, Wm. R. Eckart, H. P. Frear.

The committee has effected a permanent organization, with Prof. Wm. F. Durand as chairman, and W. A. Cattell as secretary-treasurer, and has established executive offices in the Foxcroft Building, 68 Post street, San Francisco.

The ten members of the committee, consisting of the presidents and secretaries of the five national societies, will constitute a Committee on Participation, through whom all invitations to participate in the congress will be issued to governments, engineering societies, and individuals.

The actual management of the congress and the work of securing and publishing papers will be in charge of the members of the committee resident in San Francisco. The work of the resident members has been assigned to different sub-committees, and Chairman Durand has made the following appointments, the first named being chairman in each case:

	EXECUTIVE.	
W. F. Durand	W. A. Cattell	E. H. Benjamin
W. G. Dodd	A. M. Hunt	
	FINANCE.	
W. G. Dodd	Newton Cleaveland	R. S. Moore
	PAPERS.	
A. M. Hunt	A. L. Adams	H. F. Bain
G. W. Dickie	W. R. Eckart	C. D. Marx
	C. R. Weymouth	
	PUBLICITY.	
W. A. Cattell	C. Derleth Jr.	W. S. Noyes
	T. W. Ransom	
	LOCAL AFFAIRS.	
E. H. Benjamin	J. G. De Remer	H. P. Frear

The honorary officers of the congress will consist of a president and a number of vice-presidents selected from among the most distinguished engineers of this and foreign countries.

The papers presented at the congress will naturally be divided into groups or sections. During the congress each section will hold independent sessions, which will be presided over by a chairman eminent as a specialist in the branches of engineering covered by his section.

The scope and magnitude of the congress has not as yet been definitely fixed, but it is intended that it shall be the largest and most comprehensive engineering congress ever held; that the progress made in in every branch of the profession in the past decade be thoroughly reviewed, and the latest developments and most approved practices, accurately stated by the leading engineers of the world.

The papers, which will be collected and published by the congress should form an invaluable engineering library, and it is intended that this publication shall be in such form and at such cost as to become available to the greatest possible number.

The various committees are now actively at work, and it is hoped that further and more definite announcements as to the membership fees, schedules of papers, etc., can be made in the very near future.

U. S. CIVIL SERVICE EXAMINATION FOR HYDRO-ELECTRICAL ENGINEER.

The United States Civil Service Commission announces an open competitive examination for hydroelectrical engineer, on May 13, in the Forest Service, and in the Reclamation

Service, for service in the field, at salaries ranging from $1800 to $2400 a year.

It is desired to secure men qualified to conduct expert examinations of water power sites, with theoretical and practical knowledge of hydrology and river hydraulics, and who are, in addition, thoroughly familiar with the design and operation of hydroelectrical plants and have had special experience in testing, installing and operating them from the standpoint of supplying power, and also in the use of power and pumping the water for irrigation.

Competitors will not be required to appear at any place for examination, but will be rated on the following subjects, which will have the relative weights indicated:

Subjects.	Weights.
1. General education and technical training	30
2. Practical experience and fitness	50
3. Publications or reports	20
Total	100

TRADE NOTES.

The Fobes Supply Company, Seattle, is making extensive changes in its offices at 560 First avenue South. The old offices are being entirely torn out and new ones constructed in their stead.

H. W. Johns-Manville Company have the contract for installing the illuminating equipment for the new Standard Oil Company's building in San Francisco. The principal feature will consist of 600 or more new type direct-indirect Frink reflecting electroliers.

Davis & Hull, 942 Commerce street, Tacoma, have completed plans for installation of the electrical machinery in the new furniture factory of F. S. Harmon & Company in that city. There will be a total of 20 motors ranging from 20 h.p. down to be located on four floors of the building.

The city of Linton, Oregon, has just purchased two 20 h.p. Byron Jackson turbine pumps, direct connected to two 20 h.p., 3-phase, 60 cycle, 220 volt Fairbanks-Morse induction motors. The capacity of these pumps is 75 gals per minute, each, pumping against a head of 385 ft. These pumps are to be automatically controlled and will discharge into the city reservoir.

The commercial section of Tacoma's light and power department is fitting up an office in room 402½ at the city hall. As business is growing rapidly the office is to be somewhat elaborate. The heat will be supplied entirely by electricity and various devices will be kept on hand for explanatory purposes. A. L. Thorn, former superintendent of electric works, will be in charge.

Evans-Dickson Company, electrical engineers and contractors, Tacoma, are making extensive changes and improvements in their place of business. One of these changes is to move the offices from the rear to the front of the building, remodel same and place in smaller space. A motor winding and repair department has been added. This department is to be under the direction of H. B. Taylor, a pioneer in this line of work who was engaged in business for several years in Tacoma under the name of H. B. Taylor & Company.

The Smoke River Irrigation District, whose head office is at Weiser, Idaho, have just purchased 2-150 h.p., 1-75 h.p., and 1-15 h.p. pumping units to be used in irrigating 1500 acres of their land on the Snake River, opposite Weiser, in Oregon. This installation is to be completed by the 1st of June, 1913. The primary lift is 93 ft. and is to be handled by the 2-150 h.p. and the 1-75 h.p. and the secondary lift is over a mile away from the primary lift and is 27.4 ft. and is handled by the 15 h.p. unit. The motors were purchased from the Fairbanks-Morse Company and the pumps from the Byron Jackson Pump Company.

BOOK REVIEWS.

Stone & Webster Electric Railway and Lighting Properties for 1913. Size, 5 x 7½ in.; 75 pages; leather binding. Published and edited by the Stone & Webster Management Association of Boston.

This book lists and displays by map the location of the securities of public service corporations either managed or owned by the Stone & Webster Company. In addition, valuable suggestions for guidance in transferring stock and a table detailing the approximate income from stocks paying from 4 per cent to 10 per cent are appended. The book is an excellent manual for those interested in hydroelectric securities.

Manual of Wireless Telegraphy and Telephony. By A. Frederick Collins. Third edition; revised and enlarged. Size 4½ x 8½ in.; 300 pages; 129 illustrations; cloth binding, Published by John Wiley & Sons of New York, and for sale at The Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $1.50.

The tremendous strides in wireless work during the past ten years have necessitated the publication of the third edition of this manual. The book contains all the vital points contained in earlier editions and in addition has several enlarged and useful new features. Improved apparatus are described and the superseded designs called to attention. Suggestions to operators constitute a splendid addition to the revised publication. A chapter is devoted to wireless telephony and a complete list of books and brief digest of each book on wireless telegraphy is appended. A glossary followed by an index of twenty pages complete the work. The book deserves a place high among similar publications now available.

Transmission Line Formulas for Electrical Engineers and Engineering Students. By H. B. Dwight. Size, 5½ x 8½ in.; 137 pages; profusely illustrated with diagrams and tables; cloth binding. Published by D. Van Nostrand Company of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $2.00.

The object of this book is to compile a set of instructions for engineers, which will enable them to make electrical calculations for transmission lines with the least possible amount of work. The first part of the book contains a statement of the formulas, while the latter part is reserved for proof which involves higher mathematics. Formulas for short lines, for distributed capacity, for regulation and other intricate alternating current phenomena are illustrated with completely solved problems. A salient feature of the discussion of each formula given is an estimate of the range of its accuracy quantitatively computed. The book should prove useful to transmission engineers, whether proficient or not in higher mathematics.

Electrical Meters. By Cyril M. Jansky. Size, 6½ x 8½ in.; 370 pages; 273 illustrations; cloth binding. Published by McGraw-Hill Book Company of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $2.50.

This book is the second of a series of its kind which is being written in connection with the extension division of the University of Wisconsin. The author, who is an associate professor of electrical engineering at this university, has written the text in the hopes of supplying a need felt in correspondence instruction. In classifying electrical measuring instruments, the main divisions have been made in accordance with the quantities to be measured, and minor subdivisions according to the principles of operation. This arrangement adds much for clearness and simplicity. The fundamental principles are explained in an elementary way, fully illustrated with line drawings and vector diagrams. The book is to be commended for its easy style of explanation of complicated meter principles of operation. The chapter on testing of meters and especially the one on instrument errors will prove of great value among all those having anything to do with meter study or application.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

RECOMMENDATIONS FOR ELECTRICAL INSTALLATIONS IN WOOD WORKING PLANTS, MANUFACTURING PLANTS, WAREHOUSES, PACKING HOUSES, CANNERIES, MINING PLANTS, ETC.

COMPILED BY F. D. WEBER.[1]

(Concluded.)

Outside Wiring.

25. Aerial Construction must be so placed that moisture cannot form a cross-connection between wires, and except when run in conduit, not less than a foot apart, and not in contact with any substance other than their insulating supports. Wooden blocks to which insulators are attached must be covered over their entire surface with at least two coats of waterproof paint.

For conduit work, wires must be placed so as to conform to rules for unlined conduit, except that conduit system must be waterproof. (Rule 12a to h.)

26. Lighting Over Platforms. If the lighting is to be over platforms, tramways, etc., it is much better to run the wires underneath the same. Wires to be supported at least every 10 ft. by petticoat insulators of glass. Branch wires or taps from main wires up to lamp sockets should be run in continuous lengths of approved metal conduit, extending from the under side of the platform up a good substantial lamp post. The lower end of the conduit (under the platform) must be equipped with a condulet or an outlet box, the wires passing through separate insulated holes. The upper end must be bent downward, forming an inverted "U," in order that the moisture cannot enter the conduit, and the end equipped with a condulet, or the weatherproof socket must screw directly to the conduit.

Also, open wiring may be used if same is thoroughly protected from mechanical injury. (See Division 20 of this pamphlet.)

27. Branch Circuits. The lights may be controlled from cabinets underneath the platforms.

28. Wires must be rubber covered or weatherproof, except in the conduit mentioned in Section 26, where double braid rubber-covered wires must be used. (Rules 12a and 56.)

29. Sockets must be weatherproof.

30. Arc Lamps must meet the requirements for arcs mentioned in Section 33.

31. Cabinets must meet requirements specified in Section 70 of the National Electrical Code, and Divisions 18 and 22 of this pamphlet, and in addition must be waterproof.

Motors and Motor Wiring.

32. Motors when operating at a potential of 550 volts or less must be thoroughly insulated from the ground wherever feasible. (Rule 8a.) This can most always be accomplished by a good, substantial wooden base frame. Enclose the motor in a dust-proof room where direct current motor or motors with sparking contacts, are used. Such enclosures should be readily accessible, dustproof, and sufficiently ventilated to prevent an excessive rise of temperature. The sides should be made largely of glass, so the motor may be always plainly visible.

For "high tension" motor installation, see "Wiring Data." for Direct and Alternating Current Motors," published by this Bureau, and also Rule 8, National Electrical Code.

33. Lead Wires or Branch Circuits for motors operating at a potential of 550 volts or less should be run as specified for light wires in Sections 19 and 20, or Section 23 of this pamphlet. Wires for direct current motors must be designed to carry a current at least 25 per cent greater than that for which the motor is rated, in order to provide for the inevitable occasional overloading of the motor and the increased current required in starting, without overfusing the wires. For alternating current motors the wires must be designed to carry a current at least 50 per cent greater than that for which the motor is rated. (See Rules 8-23 e and f; "Wiring Data for Direct and Alternating Current Motors," published by this Bureau and Section 7 of this pamphlet.)

34. Cutouts. It is recommended that cutouts be assembled at a center of distribution and placed in approved cabinets as specified in Sections 18 and 22 of this pamphlet. For alternating current motors there must be provided a starting and a running fuse. Running fuses and controlling switches if exposed to dust, moisture or mechanical injury must be placed in approved cabinets. (See "Wiring Data for Direct and Alternating Current Motors," published by this Bureau.)

35. Resistance Boxes must be placed on a switchboard or be mounted one foot from combustible material, or be separated therefrom by a slab of slate or marble. This will require the use of a slab of slate or marble somewhat larger than the rheostat, and must be secured in position independently of the rheostat supports. Bolts for supporting the rheostat shall be countersunk at least one-eighth inch at the back and filled. If the rheostat is exposed to dust it must be installed in an approved cabinet. (Rule 4a.)

36. High Potential Motors. Motors operating at a potential between 550 and 3500 volts must be installed according to Rule 8a. High potential motors may be wired open according to Rule 44, when the wires directly enter the motor room. This cannot be accomplished unless the motor house is against the outside wall of the building.

Inflammable Gas and Highly Combustible Dust.

37. Installation of sparking contacts where these conditions exist, such as key sockets, knife or snap switches, fuses (open or enclosed), motors, etc., will not be sanctioned by this Bureau. All switches and cutouts must be placed on outside of buildings where these conditions obtain.

[1]Electrical Inspector for Underwriters' Equitable Rating Bureau, Portland, Oregon.

NEWS OF WASHINGTON PUBLIC SERVICE COMMISSION.

The public service commission of Washington has decided that it will not permit the Puget Sound Traction, Light & Power Company to put into effect its rates on large contracts without the statutory 30 day notice. It was the intention of the company to put into effect a contract that would only reach those who would guarantee a minimum of business amounting to $10,000 and enter into a 10-year contract. The rate was filed April 2 and the commission decided that it could not go into effect until May 2.

W. V. Tanner, attorney general of Washington, under authority vested in him by the recent legislature, has secured the services of additional counsel to assist the state in fighting the suit started some time ago by the Puget Sound Electric Company against the Public Service Commission. This company operates the interurban line between Seattle and Tacoma. The company is seeking to have the order of the public service commission nullified which restored the old rates out of Seattle for a distance of twelve miles and for the same distance out of Tacoma. The old rates were in existence before the exposition in 1909. The company contends that the rate established by the commission amounts to confiscation. The state will fight the case through the federal courts.

INDUSTRIAL

MOST POWERFUL ELECTRIC LOCOMOTIVES IN THE WORLD.

Known as the "New high speed marvel," ten passenger electric locomotives of the most powerful type ever built are to be placed in commission by the New York Central & Hudson River Railroad Company out of New York City. A very exhaustive series of tests and trial runs of an experimental locomotive of this type was recently made on the Harlem Division. This locomotive was immediately put in service on the electrified section of the New York Terminal and a contract was awarded the General Electric Company for nine additional locomotives of the same design, which are now under construction.

The new electric engines will exert sufficient tractive effort to haul a train weighing 1000 tons at 60 miles per hour. In regular service they have a capacity for developing 1400 h.p. continuously and can develop as high as 5000 h.p. for short periods. Compared with existing types of electric locomotives, this machine has greater capacity and higher efficiency than any other high speed electric locomotive ever constructed. Withal, its total weight, weight on the drivers and "dead" weight is less than that of its nearest competitor.

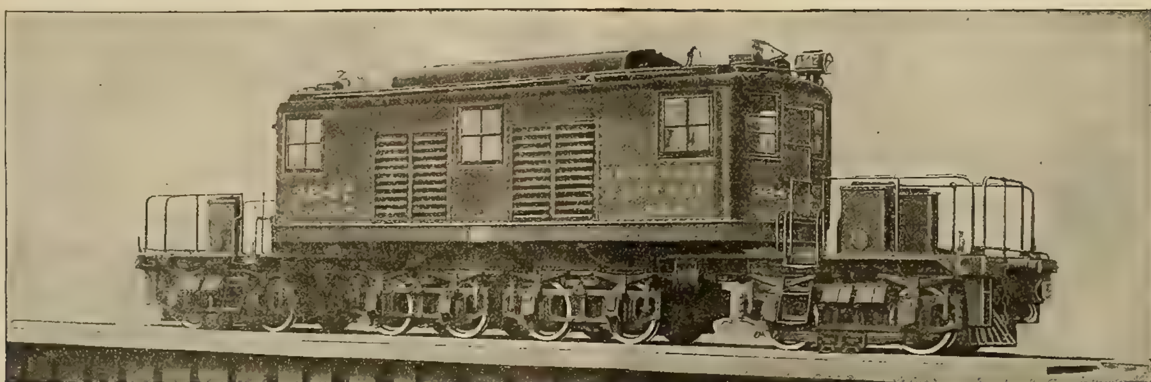
In general, the locomotive may be described as having an articulated frame with bogie guiding trucks at each end. The cab containing the engineer's compartments and that for the operating mechanism is swung between the two parts of the frame on the center pins. Each section is equipped with two two-axle trucks having a driving motor mounted on each axle.

The cab carried on the two center pins, has its weight distributed between the two halves of the locomotive frame. It is the box type 35 ft. in length and 10 ft. wide. The interior is divided into three sections. A motorman's compartment is located at either end and contains the motorman's seat, controller, air brake, valves, bell and whistle rope handles, and such parts of the control apparatus as have to be within reach of the operating engineer. In the central section of the cab are the air compressors, blowers, contactors rheostats, grouped so that they are conveniently accessible for inspection and repair, and separated from the direct reach or attention of the operating engineer. The advantage of this arrangment is that it removes from the sight of the engineer running apparatus which might serve to distract his attention from the actual work of handling the locomotive and which can be inspected and attended to by his assistant. This general type of construction leaves a fairly long platform on either end of the locomotive. Access to the cab is obtained through doors opening onto the platform.

The principal data and important dimensions applying to the locomotive are the following:

Length inside of knuckles	55 ft. 2 in.
Length over cab	33 ft.
Height over cab	12 ft. 8 in.
Height with trolley down	14 ft. 6 in.
Width over all	10 ft.
Total wheel base	45 ft. 7 in.
Rigid wheel base	5 ft. and 6 ft. 6 in.
Total weight	200,000 lbs.
Weight per axle	25,000 lbs.
Dead weight per axle	6,395 lbs.

Current is collected by eight underrunning third rail shoes, or by two overhead trolleys when on gaps on the third rail. The overhead trolleys are the pantograph type and are pneumatically operated. They can be put into service from either engineer's position by a foot-operated valve. The trolley is designed for intermittent use and is therefore arranged to be held in a raised position only while the valve is held open by the engineer's foot.



Side View N. Y. C. & H. R. R. R. Electric Locomotive.

The headlights are the incandescent type with parabolic reflectors 16 in. in diameter. The interior illumination of the cab is provided by ten incandescent lamps arranged in two circuits, two lamps being located in each engineer's cab and the balance in the central compartment. In each lamp circuit is a portable lamp with extension cord 25 ft. long. One lamp switch is located in each engineer's compartment, so that from either end of the locomotive the lamps can be controlled in that compartment, as well as half of the lamps in the central compartment.

Electric heaters are placed in the two engineer's compartments. The heaters are a standard electric car type, fitted with especially heavy outside covers to protect them from the mechanical injuries to which they are exposed in locomotive service.

NEW CATALOGUES.

The Bowie Switch Company of San Francisco has issued an interesting and attractive bulletin on the application of Bowie high tension circuit breakers to out-door substations.

A new standard price list on "Sterling" new code rubber covered wire has been issued by the Standard Underground Cable Company, Pittsburgh, Pa, The price list is in convenient and durable booklet form in two colors and gives prices on their "Sterling" wire for bases ranging from 13 to 20 cents for solid and stranded wire of all commercial sizes. Appended are explanatory notes and a list of electric wires and cables and cable accessories manufactured by this company. The price list will be sent on request to the company.

NEWS NOTES

ILLUMINATION.

YONCALLA, ORE.—E. S. Benefiel, Paisley, will soon begin work on a power plant to furnish power and light for Yoncalla.

EMMETT, IDAHO.—The Beaver River Power Company has asked for a franchise to enter Payette valley to furnish power and light.

STREVELL, IDAHO.—A company is being formed to construct a power plant on Clear creek, to manufacture power and light for this place.

FLAGSTAFF, ARIZ.—A special election will be held May 6th, when the question of granting a franchise to the Flagstaff Electric Light Company shall be voted upon.

LOS ANGELES, CAL.—Chief Electrician of the Standard Oil Company and the assistant are at Newhall, where an electrical plant similar to the one at Taft is being installed.

SALINAS, CAL.—This city is about to install a modern system of street lighting. Plans and specifications are out for bids. Charles T. Phillips, consulting engineer, designed the installation.

DINUBA, CAL.—A. A. Weber has filed an application for a franchise to construct, maintain and operate a gas system in this city. Sealed bids will be received for the sale of the franchise, up to June 4th.

PALO ALTO, CAL.—The city council voted unanimously in favor of a resolution urging immediate acquisition by the city of a gas manufacturing plant. The city already owns all water and electric light and power plants.

PORTLAND, ORE.—Good Samaritan Hospital, Portland, Oegon, is contemplating an isolated heating and electric lighting plant. Mr. W. S. Turner, Spaulding, Building, is consulting engineer for the hospital association.

ANGELES, WASH.—The council has instructed the electric light committee and the engineer of the city light plant to bring in at the next meeting of the council an estimate of machinery required for a complete new permanent lighting plant.

OAKDALE, CAL.—An application has been filed for a franchise granting the right to lay pipes and conduits for a period of 50 years in the city of Oakdale, for distributing gas for light, heat and power. Sealed bids will be received up to June 2, for the sale of the franchise.

SAN BERNARDINO, CAL.—The Southern California Gas Company has announced plans to extend its lines in San Bernardino valley into new fields. From the main distributing plant at Colton gas will be piped to Loma Linda sanitarium and colony. With the completion of this, the crew will be transferred to construct a similar line to Bloomington.

TACOMA, WASH.—The city council of Tacoma has adopted the rate at which it will sell power for industrial purposes. There are two other rates yet to be established. One of these is to be the combination residence light and cooking rate. The other will be the business rate. This rate will depend entirely upon the hours burning. This will range from 3.3 to 24 hours a day. The man who runs the most hours will receive the benefit of the lowest rate per kw. hour. These rates will be settled so as to go into effect by May 1st.

LOS ANGELES, CAL.—The railroad commission Saturday authorized the Los Angeles Gas & Electric Corporation to purchase the Valley Gas & Fuel Company and the California Coke & Gas Company of Pasadena and to issue $900,000 of bonds. The bonds are to be used for the acquisition of the two companies in Pasadena and for the following improvements and extensions of the existing plant. Additional gas generating set and new equipment, $169,000; extension of distributing system, for new consumers, $600,000; extension of electrical distributing system, $280,000.

TRANSMISSION.

FAIRBANKS, ALASKA.—Tanana Water & Power Company, represented by John L. Timmins, is planning a power project in Tatlanika country, 100 miles from here.

EVERETT, WASH.—The Puget Sound Traction, Light & Power Company is getting ready to construct a transmission line from its Snoqualmie power plant to Everett, a distance of 40 miles for suburban service, and will supply the towns of Tolt, Redmond and Kirkland on the eastern shore of Lake Washington with light and power.

SALT LAKE, UTAH.—With the advance of spring the Utah Power & Light Company is at work increasing the capacity of its Idaho plants so that the two additional steel power lines to Salt Lake and the terminal substation between Salt Lake and Garfield may be completed and the additional power ready for use by January 1st.

DEMING, NEW MEXICO.—Geo. Gauthier, Chas. Johan and W. O. Vickery of the Federal Light & Traction Company are in Deming and construction work on the new electric power plant and high tension transmission line to the Miesse tract, 14 miles east of Deming has been started. All of the No. 6 copper wire now used as the high tension transmission line, carrying 13,000 volts, will be taken down, and No. 2 copper wire substituted to carry 22,000 volts.

LOS ANGELES, CAL.—Following are the results of the bond election: No. 1—$6,500,000 for a power distributing system; defeated, for 30,673, against 20,805. No. 2—$1,500,000 to convey the Owens River water from the end of the aquednct to the city carried, for 41,177, against 5446. No. 3—$2,000,000 to convey the surplus aqueduct water to agricultural consumers and others in San Fernando Valley; defeated, for 21,887, against 27,878. No. 4—$2,500,000 to begin the construction of a $7,000,000 to $10,000,000 highline aqueduct to Pasadena, Glendora and San Dimas; defeated, for 15,844, against 33,001. No. 5—$2,500,000 for harbor construction; carried, for 46,803, against 5017. No. 6—$1,000,000 to acquire land and build a city hall; defeated, for 8007, against 41,491. No. 7—$1,000,000 to begin the construction of a municipal railroad; defeated, for 22,932, against 24,778. No. 8—$600,000 to acquire the site of the State Normal School; defeated, for 10,247, against 34,991.

TRANSPORTATION.

LEWISTON, IDAHO.—The Lewiston-Clarkston Valley Railway Company, F. L. Sturm, president, will start at once on the final revision of plans for the equipment and installation.

OREL, CAL.—The Pacific Gas & Electric Company has opened its railroad from Orel to its camp at Drumm. The road has been closed by snow since January. A force of men is now at work on it.

CALDWELL, IDAHO.—The Caldwell Traction Company, backed by the Sevree interests, have started work on tne extension of electric lines into the territory of the Boise reclamation project, Deer Flat territory.

CORONA, CAL.—Sealed bids will be received up to June 3d, by the board of trustees, for franchise, applied for by the Pacific Electric Company to construct and maintain for a period of 50 years, a single or double railway track.

CENTRALIA, WASH.—The Willapa Bay & Eastern Railroad has filed articles of incorporation for $2,000,000. The incorporators are Judge W. H. Bogle, chief counsel O.-W.

R. & N and F. Merritt and C. P. Bissett, O.-W. R. & N. line from Centralia to Willapa Harbor, 51 miles, will be begun at once.

VENICE, CAL.—A movement to have the Eighth street car line in Santa Monica extended to the back country in Venice to connect with the Pacific Electric short line has been launched by the Venice Civic League. A committee has been appointed to lay the matter before Paul Shoup, president of the Pacific Electric Company.

SAN JOSE, CAL.—Following the presentation of a protest signed by forty residents of the east side of the valley, an ordinance granting the Peninsular Railroad a 50-year franchise on Alum Rock avenue, from the city limits to Kirk avenue, was referred back to the ordinance committee of the supervisors. The protestants asked that no franchise be granted except for a road on Alum Rock avenue, straight into the reservation, or else connecting with the Berryessa line near Hoyon station, thus giving the east side a loop similar to that on the west side of the valley.

LOS ANGELES, CAL.—The commission has authorized the Pacific Electric Company to issue bonds to the amount of $6,839,000, the money from the sale of these bonds to be used for extensions and improvements to the Pacific Electric Railway radiating from Los Angeles, the money to be applied upon the following: Extensions and branches, $3,428,518.36; additional main tracks, $43,567.53; tunnels, bridges, etc., $444,609.81; real estate, $39,975.22; stations, shops, etc., $156,787.54; light and power plants, $216,962.27; water and water rights, $940; rolling stock, $1,554,911.23; additions and betterments, $699,410.08; total, $6,585,682.04.

SAN FRANCISCO, CAL.—The board of works received nine bids for the construction of the roadbed of the Geary street line from 33d avenue to the Great Highway, the route being along Thirty-third avenue, Balboa street, Forty-fifth avenue, and Cabrillo street, to the beach, a distance of 7400 feet. The Healy-Tibbitts Construction Company put in the lowest bid, $34,450. The other bids were: T. H. Mullin, $35,900; F. E. Hilmer, $39,340; Mahoney Bros., $44,710; Central California Construction Company, $47,540; F. Rolandi $48,295; Gorrill Bros., $51,187; Contra Costa Construction Company, $53,880; Grant, Smith & Company, $77,760. The contract is to be awarded soon.

SAN FRANCISCO, CAL.—Plans for the municipal railroad extension to be made before the exposition in order to meet the exposition traffic demands were taken up by the public utilities committee of the supervisors with a consideration of the city engineer's report. The committee plans to report to the board soon with a resolution calling a special election for the issuance of bonds for the extensions. Supervisor Vogelsang voiced the attitude of the committee in stating that only plans for the permanent extension of the municipal railroad that will act as feeders for the exposition will be considered in the report and that no lines will be recommended that will not be of general and immediate use after the exposition closes. He also said that the extensions shall be constructed for ordinary operation and that the city shall not incur extra expense for special operation equipment and facilities for the exposition. The plan which seems to meet the favor of the committee is the construction of the Van Ness avenue line, Potrero avenue, Stockton, Union and North Point, Steiner and Chestnut lines. This involves only one tunnel, the Stockton street tunnel. The cost is estimated by the city engineer at $2,437,000 for ordinary operation.

TELEPHONE & TELEGRAPH.

SAN FRANCISCO, CAL.—The supervisors at a recent meeting adopted by unanimous vote resolutions calling for the acquisition by the federal government of the telegraph and telephone lines.

LA GRANDE, ORE.—A franchise has been granted to the Eastern Oregon Co-operative Telegraph Company to enter the city.

ANACORTES, WASH.—The Pacific Telephone & Telegraph Company are preparing to lay a new 25-pair double armored cable to Guemes island.

UKIAH, CAL.—The Redwood Valley Rural Telephone Company has been granted a permit to erect poles and string wires and maintain same as a private rural telephone line.

PLAINS, MONT.—The Mountain States Telephone Company, Geo. L. Pavy, manager, will ask the government for a permit to construct a 150 mile pole line on the Flathead reservation.

MOUNTAIN HOME, IDAHO.—Messrs. Farday and Reynolds, Mountain Home, have presented an application of the Southwestern Idaho & Nevada Telephone & Telegraph Company to the county commissioners, for a franchise for a telephone and telegraph line in Canyon county.

VALLEJO, CAL.—The public works officials at the Mare Island navy yard have forwarded to the department at Washington a recommendation for the increase of the telephone capacity at Mare Island and with the recommendation have forwarded also estimates of several San Francisco concerns on the work of installing the increased equipment.

EUREKA, CAL.—Material is being received for increasing the power of the government wireless station at Table Bluff. The masts are to be increased 50 ft. in height, while the power of the transmitting apparatus will be increased. When the changes which are now being made by a crew of 25 men have been completed the station will be one of the most powerful on the Pacific Coast.

WATERWORKS.

LEAVENWORTH, WASH.—The city has decided to buy the water system of the Tumwater Light & Water Company for $7,560.40.

TUCSON, ARIZ.—Relief for the northside is included in plans for improved water system to be presented to the city council by city engineer, J. Moss Ruthrauff.

DAVIS, CAL.—The board of supervisors has granted the Schemeiser Manufacturing Company authority to lay water mains along all streets, lanes and alleyways of this city.

LINTON, ORE.—The city council has awarded to the James Kennedy Construction Company of Portland, a contract for the construction of the new pipe line. The contract price was $92,739.

CLAREMONT, CAL.—The Citizens' Light & Water Company and the Claremont Domestic Water Company have applied to the commission for an order authorizing the former to sell its property to the latter at an agreed price of $78,000.

EL CENTRO, CAL.—The board of trustees has resolved that public interest and necessity demands a municipal waterworks system for this city, said system to include acquisition of lands, water rights and construction of ditches, canals, reservoirs, distributing system, pumping and purification plants, etc. The estimated cost is $50,000.

TULARE, CAL.—F. T. Robson, of Sloan & Robson, the engineers for the new city water system arrived here in company with C. R. Sessons an engineer. They have been looking over the pumping plants of the Old Tulare City Water Company with the view of drawing up specifications for new machinery. These specifications will be used in bids for the purchase of such new machinery.

RIVERSIDE, CAL.—It has been decided to begin proceeding anew for the issuance of $1,160,000 in bonds for the purchase of existing water systems, and their combination and extension into a municipal system. Owing to the inability of the city under the present market to sell the 4½ per cent bonds, the council authorized the calling of an election to be held May 19th. The interest is to be placed at 5 per cent.

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE—Two steel tanks, 6 ft. by 12 ft., with convex heads; sheets ½ in. and heads ⅜ in. These tanks are new and only partially built. A bargain. San Francisco Disposal Co., Evans and Keith Streets, San Francisco.

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Valle," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Manhattan Elec. Supply Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg.Co.

Automobile Horns, Electric
Dean Electric Co.
Manhattan Elec. Supply Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Edison Storage Battery Supply Co.
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Manhattan Elec. Supply Co.
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co.,The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg.Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
Geo.E.DowPumpingEngineCo.
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg.Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Oil
Fairbanks, Morse & Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg.Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Westinghouse E. & M Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Dow Pump'g Engine Co.,Geo.E.
San Francisco, Sheldon Bldg.
Los Angeles, 235 S. L. A. St.

Economy Electric Co.
San Francisco, 444 Market

Edison Storage Battery Supply Co.
San Francisco, 818 Mission.

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 807 Mission.
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holophane Works of G. E. Co.
San Francisco, Aranson Bldg., 3rd and Mission Sts.

Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Fairbanks, Morse & Co.
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-**Reynolds Co.**
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
Pierson, Roeding & Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Tungsten, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
Fairbanks, Morse & Co.
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.
Manhattan Elec. Supply Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase R. J.
Davis, R. R. Poppleton, W. M.
Price Co., A. T. Egan.
Fairbanks, Morse & Co.
General Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Mannesmannrohren-Werke
Pittsburg Piping & Equip. Co

Plugs, Flush
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Air
Geo.E.DowPumpingEngineCo.

Pumps, Boiler Feed
Fairbanks, Morse & Co.
Geo.E.DowPumpingEngineCo.

Pumps, Centrifugal
Byron Jackson Iron Works.
Geo.E.DowPumpingEngineCo.
Fairbanks, Morse & Co.

Pumps, Deep Well
Geo.E.DowPumpingEngineCo.
(Pulsating & Non-Pulsating)
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Triplex
Geo.E.DowPumpingEngineCo.

Pumps, Vacuum
Geo.E.DowPumpingEngineCo.
Simonds Machinery Co.

Push Buttons
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Reflectors
Holophane Works of G. E. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 807 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Manhattan Elec. Supply Co.
San Francisco, 403 **Atlas** Bldg., 604 Mission St.

Mannesmannrohren-Werke
San Francisco, Rialto Bldg.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Nason & Co., R. N.
San Francisco, 151 PotreroAve.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Ohio Brass Co.
San Francisco, 527 Mission.
Los Angeles, 218 E. Third.
Seattle, 307 First Ave. So.

Okonite Co.
All jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pass & Seymour
San Francisco, Rialto Bldg.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto **Bldg.**
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman **Bldg.**
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific **Bldg.**

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
SanFrancisco MonadnockBldg

Poppleton, R. R
20 N. 12th St., Portland. Ore.

Post Co., The Frederick
San Francisco, 135 Second

Price Co., W. Montelius
Seattle, Wash.

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer.
San Francisco, 102 Steuart.

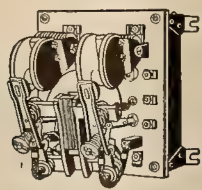
Standard Und. Cable Co.
San Francisco, First National Bank Bldg
LosAngeles, Union Trust Bldg

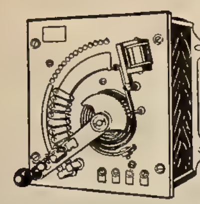
Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Pass & Seymour.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill,"Pierson, Roeding & Co.
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Westinghouse E. & M. Co.
Switches, Push Button
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Tubes and Bushings
Ohio Brass Company
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee,"Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co.,The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

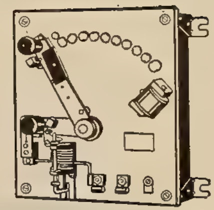
ADDRESSES.

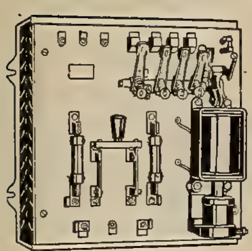
Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758W.Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 PacificBlg.
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco,682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

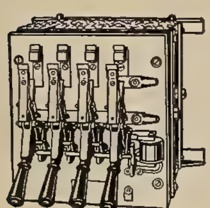
PROFESSIONAL DIRECTORY

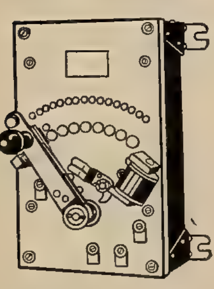

Magnetic Self - Starting Switch for A. C. Motors. Bulletin 9600.


Compound Regulator for providing Wide Speed Variation. Bulletin 3260.


Motor Starting Rheostat with Adjustable Indicating Overload Device. Bulletin 2210.


Automatic Motor Starter. Bulletin 6100.


Large Capacity Multiple Switch Motor Starter. Bulletin 2130.


Combined Motor Starter and Regulator. Bulletin 2230.

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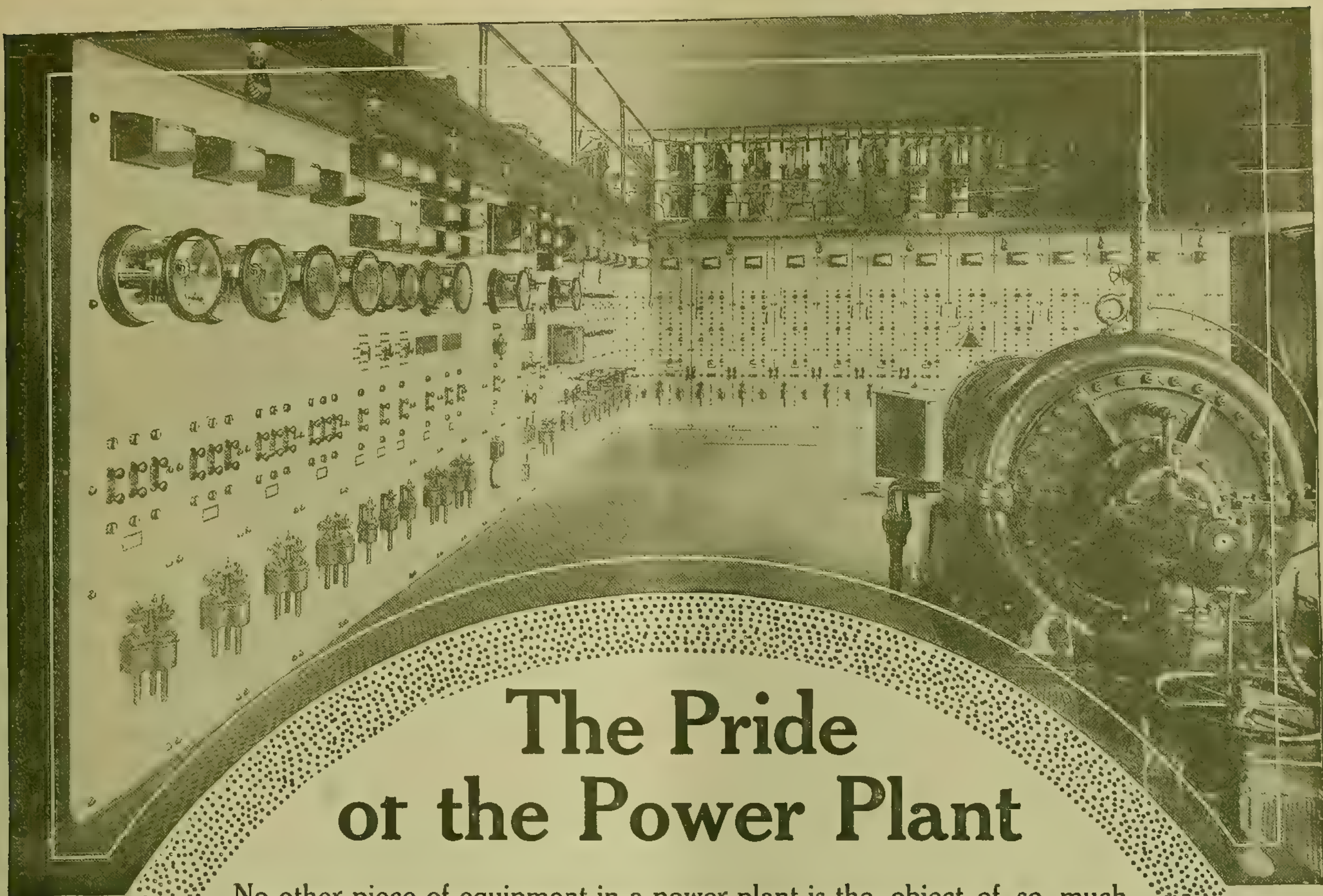

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX | SAN FRANCISCO, MAY 3, 1913 | NUMBER 18

THE LAKE UNION AUXILIARY PLANT

BY J. D. ROSS.

Complete efficiency tests have recently been completed on the 1500 kw. auxiliary generating station of the Seattle municipal power plant. This station is interesting from the fact that it receives its water supply from the municipal water system. The plant is situated on the east shore of Lake Union, near the geographic center of Seattle, and immediately below the intermediate service reservoir of the water system, which is at the top of the high bluff overlooking the lake. The overflow from this reservoir was formerly spilled into the lake and since the reservoir is 412 ft. above the lake and the amount of overflow is approximately 60 second-feet, the power available amounts to some 1500 kw. at the switchboard.

Fig. 1. Exterior View of Auxiliary at Seattle, Utilizing Waste of City's Reservoir for Domestic Waters.

From the reservoir a steel penstock 40 inches in diameter and 3400 ft. long carries the water to the wheel, which is of the Francis turbine type, made by the Pelton Water Wheel Company, and rated at 2500 h.p. at 380 ft. head and 720 r.p.m. The generator, direct connected, is a two-phase, 2500-volt, Westinghouse machine, and feeds directly into the main 2500 volt bus at the city substation at Seventh avenue and Yesler Way through a special tie line of 819,000 cir. mil aluminum stranded cable. Mounted on an extension of the generator shaft is a laminated fly-wheel, which is of material assistance in securing close regulation. The water wheel governor is Lombard Type P, operating in conjunction with a synchronous relief valve

on the turbine, which secures good regulation and absence of surge in the penstock even when the full load is dropped from the generator. The exciter unit consists of an overhung Pelton wheel, a 30 kw., 120-volt generator and a 220-volt, 2-phase induction motor assembled on the same shaft. The station building is of reinforced concrete, located on the steep bank between Eastlake avenue and the edge of the lake, with the upper floor on the street level and the lower story, which contains the machinery, a few feet above the lake level.

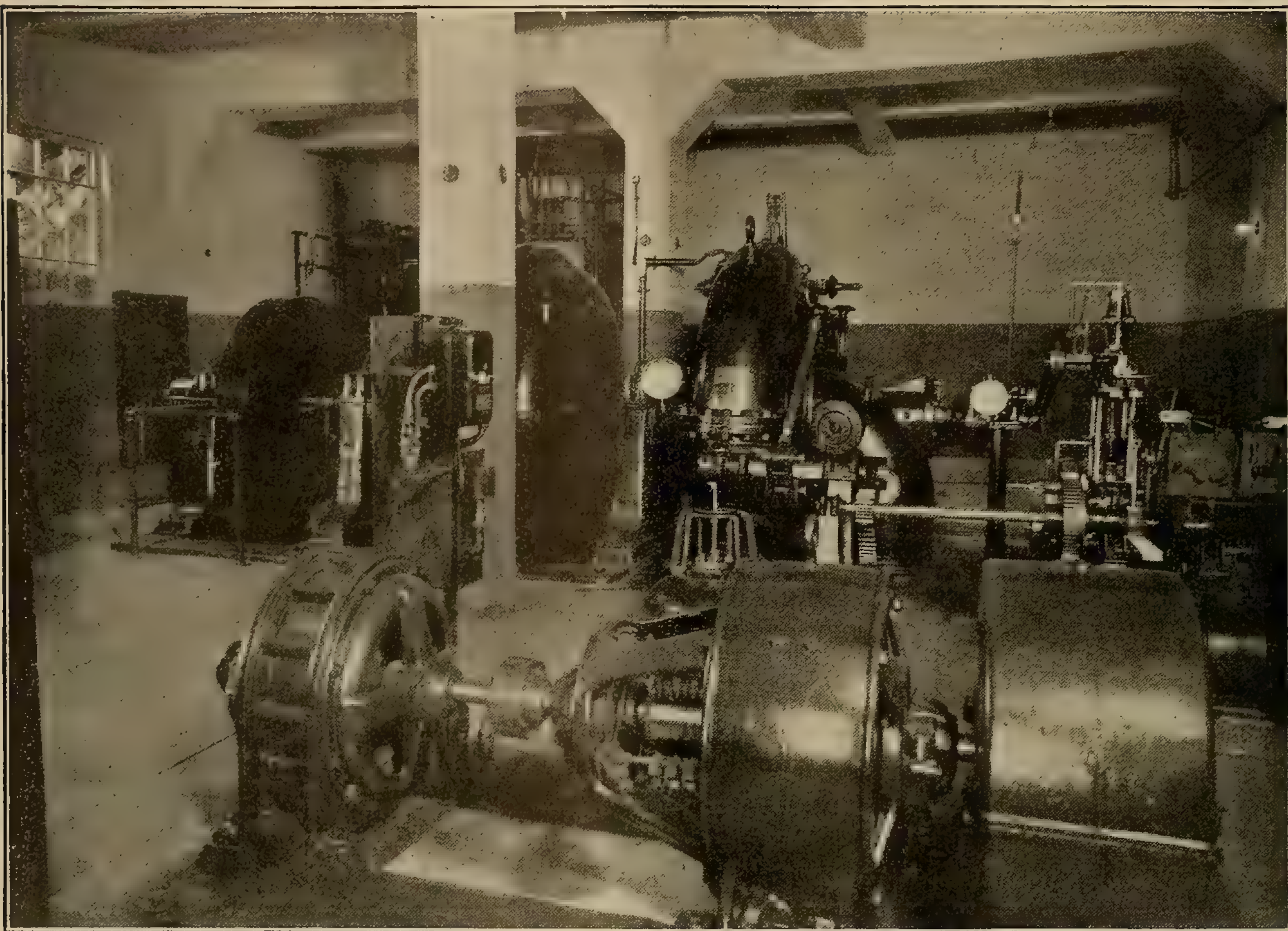


Fig 2. Interior View of the Lake Union Auxiliary.

The efficiency tests were conducted under the direction of Dr. C. E. Magnusson of the electrical engineering department and Prof. C. W. Harris of the civil engineering department of the University of Washington. The students of the junior and senior engineering classes assisted in taking readings. The water output from the generator was measured by wattmeter, using a water rheostat for load. The rheostat consists of four sheets of No. 12 gage iron, each 4 ft. by 8 ft., stretched by strain insulators on a frame so as to be held rigidly 6½ in. apart. This rheostat was lowered into the lake by means of pulleys, and gave 1500 kw. at 2500 volts when all submerged. The accompanying curve, Fig. 3, shows the wheel efficiency obtained, which is considered excellent, considering the head on the wheel and the small linear dimensions of the runner. Care was used throughout the test to secure accuracy, instruments were calibrated before and after, and leakage from the flume accounted for.

As its name signifies, this plant was built as an auxiliary to the Cedar Falls generating station and it is held ready at all times to be put into service to carry its full capacity in case of accident to the main generating station, or to assist in carrying heavy peaks on the system. Since the peak amounts to over 8000 kw., this station is of use only to help out the larger station; bonds have been voted and plans are ready for

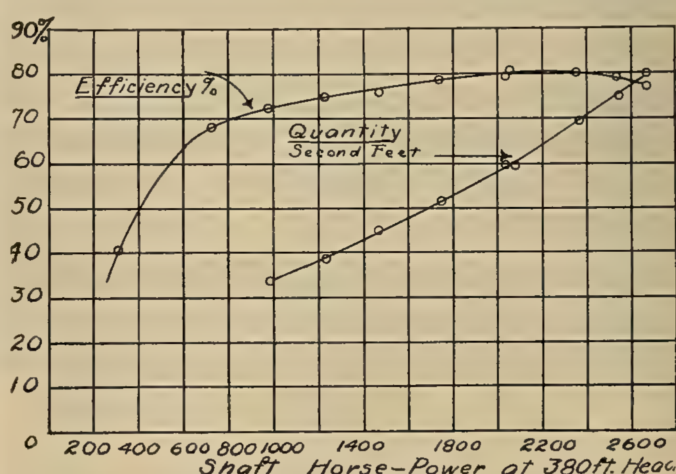


Fig. 3. Efficiency of Turbine and Quantity of Water Utilized at 380 ft. Head for Varying Horsepower at Shaft.

a 10,000 kw. steam plant to be erected immediately at the same site, in order to guarantee the continuity of the city's service.

ELECTRICAL PUMPING AND IRRIGATION

Flumes.

BY B. A. ETCHEVERRY.

Flumes are used for two purposes. The first is the conveyance of water over depressions, in which case the flume box or channel is supported by means of a substructure which may be wooden piles, a wooden or steel trestle, a concrete arch, concrete piers or reinforced concrete columns. The second is the carrying of water along steep hillsides, in which case the flume is a bench flume supported entirely or partly on a bench cut in the hill. When only partly supported on the bench it requires more or less substructure. Flumes may be classified according to the material used in forming the waterway. The following types are used:

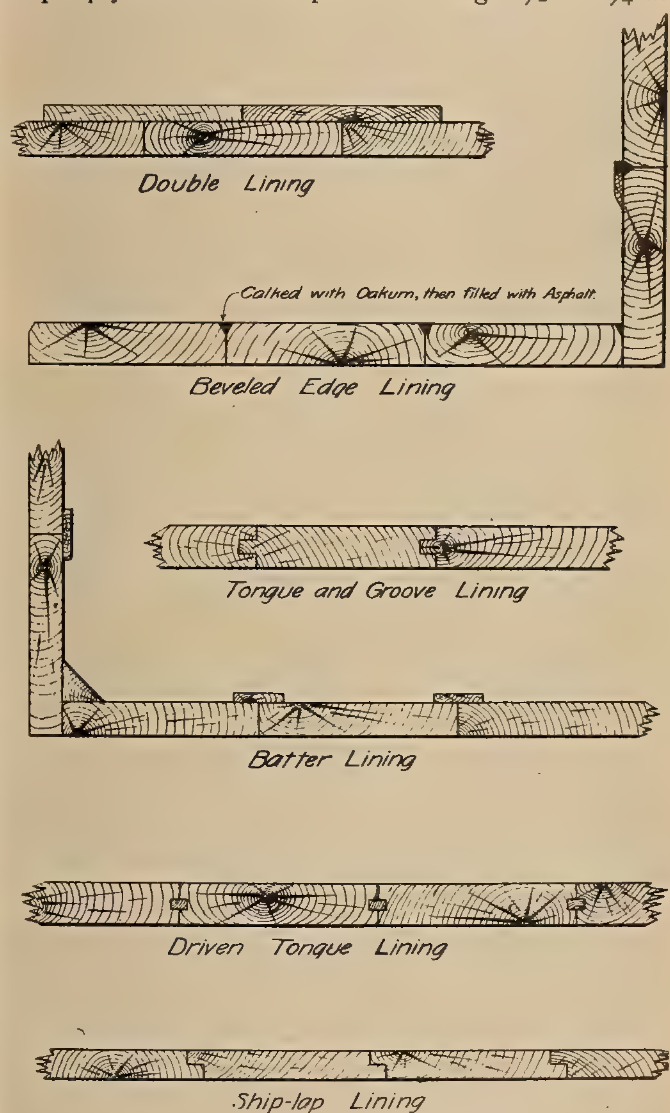
1. Wooden rectangular box flume.
2. Wooden stave, semi-circular flume.
3. Steel flumes or metal sheet flumes.
4. Reinforced concrete flume.

Wooden flumes have been extensively used ever since the beginning of irrigation. They have been used on trestle tor crossing ravines, and as bench flumes for many miles of the upper diversion lines of irrigation systems located on the steep hillsides and rocky canyons where the construction of a canal would be difficult or impossible and would be a source of danger. As long as lumber is cheap the low first cost and ease of construction make it very attractive, but the high cost of maintenance and their comparatively short life make them a large source of expense to many irrigation systems. For these reasons some of the irrigation companies are replacing their wooden bench flumes with concrete retaining walls and lining and the wooden flumes on trestle are being replaced by metal on concrete flumes and in many cases by siphons.

Rectangular Wooden Flumes.

The flume box which forms the waterway consists of the flume lining and the frame work to which the lining is nailed. The waterway is generally made with the bottom width equal to twice the depth of water and the flume lining is extended on the sides 6 in. above the full supply water level.

The flume lining should be made of well seasoned lumber free from knots. The different forms of joint lining are shown in the accompanying sketches. The butt joint lining generally leaks and requires caulking with oakum. It is generally made of 2 in. lumber. If the lumber is not well seasoned the joints will open ¼ of an in. or more. The batten joint lining is made by using 1 x 4 or 1 x 6 battens over the joints. The battens increase the cost and are liable to warp and pull away from the joints. The battens are often placed on the inside. It is preferable to place them on the outside where they do not interfere with the flow and would favor the filling of the joints with sediment. The double lining may be formed by using two layers of the same thickness or two layers of different thickness. The thickness generally used are one and two inches. It is preferable to place the thicker lining on the inside. This type of lining is extravagant in the use of lumber and not satisfactory. The tongue and groove joint is not satisfactory because of the cost of milling and the liability of the splitting of the sides of the grooves or of the tongue when the lining warps. The driven tongue lining is very satisfactory. It requires lumber at least 2 or 2½ in. thick. The grooves will be made ⅝ in. thick and ⅞ or 1 in. wide. The ship-lap joint is well adapted for linings 1½ to 1¾ in.



Details of Lining for Wooden Flumes.

thick. It requires from 8 to 9 per cent more lumber to allow for the lap but the cost is much less than that of a double lining and if shrinkage occurs the open joint can easily be calked.

The framework of the flume box consists of side yokes or posts to which the side lining is nailed; sills or stringers to which the floor lining is nailed; tie beams or braces to hold the side yokes in place; and a foot walk. The form of the framework depends somewhat on the substructure supporting the flume box. The substructure may be mudsills, piles and trestle. There are two standard forms of flume box depending on whether the floor lining

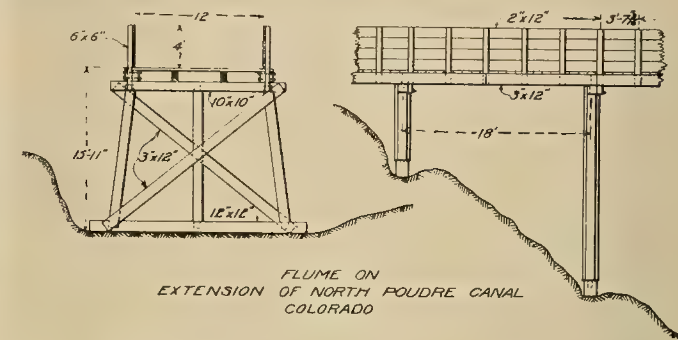
runs longitudinally or transversely. These are shown in the accompanying sketches. With the first type illustrated by the Delaney flume, of the Turlock main canal, California, and by the flume of the Kern River Power Company, California, the floor is nailed to sills which are connected to the side yokes. With the second type illustrated by the flume of the South Alberta Land Company, Canada, and the North Poudre Canal, Colorado, the floor is nailed to stringers. The first type is the one most commonly used. It has the advantage

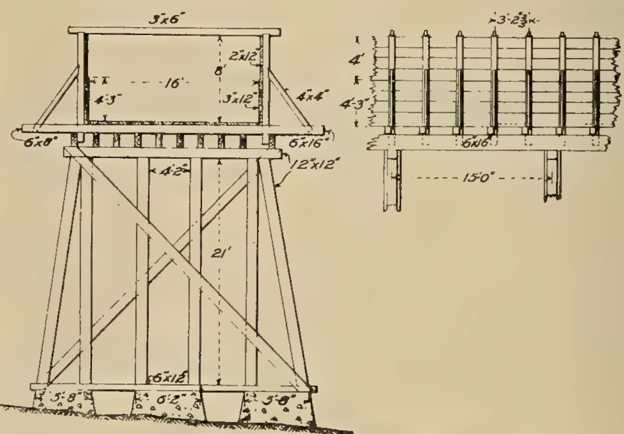
Flume on Turlock Main Canal, California.

that the lining is placed in the same direction as the flow, while with the second type the floor lining is at right angles to the direction. The second type requires less material if the flume box is supported on trestle. For the second type the side posts are single pieces usually connected at the top by a tie team and at the bottom are bolted or fastened to the stringer. The tie beam is sometimes omitted for shallow flumes. The connection with the stringer gives the sides lateral bracing against wind pressure. For the first type the side posts are made either of one piece or of two pieces. They are held at the top by a tie beam or the tie beam may be omitted and for it an inclined brace extending from the floor sill to a point in the upper half may be substituted. The use of a tie beam is usually more economical for flumes up to 20 ft. in width. The use of cross braces gives greater stiffness. It is customary, especially for flumes on trestle, to provide some cross bracing. This is done by placing inclined braces at every second or fourth post, or only at each trestle bent. Sufficient lateral stiffness for a flume of this type when on trestle may be obtained by making the side posts of two pieces extending on each side of the floor sill and resting against the side of the stringer. When the side post is made of one piece it is usually of the same thickness as the floor sill and toe-nailed to it, and if there is any likelihood of the flooring settling away from the posts and sides, straps of steel should be bolted to each post and to the sill on which it rests. To tighten the joints in the side lining it may be desirable to provide for wedges between the tie beam and the upper edge of the lining.

The substructure is usually one of the following types: mudsills, piles, posts on concrete footings, wooden trestle on concrete footings, wooden trusses. In a few cases steel trestle and trusses have been used. Mudsills are used for bench flumes. They are usually made of 2 in. x 12 in. or 3 x 12 planks laid directly on the ground. If the floor lining is placed longitudinally, the floor sills are transversal and the mudsills on which the floor sills rest are placed longitudinally. For small flumes two rows of mudsills are needed; for larger flumes three or more rows. For flumes of the second type the mudsills are placed transversally.

Piles or posts are used when the flume is entirely above ground or when the flume is partly supported on a bench. Posts are preferable to piles because of the early decay of piles at the ground surface. For flumes placed on a sharp curve it is advisable to anchor with drift bolts or otherwise to the side hill. A flume supported on posts requires two or more posts to each bent and the design is similar to trestle except that the posts are shorter and no lateral bracing is necessary.





Flume of Kern River Power Company.

A trestle consists of frames or bents spaced at regular intervals on which the flume box is supported. Wooden trestles are of the same type as the ordinary railroad trestle. For small flumes the trestle bent is formed with two inclined supports. For larger flumes three or more supports are necessary. A one-story trestle bent consists of two or more posts connected at the top with a cap and at the bottom with a sill with the necessary sway braces and sash braces. The height from cap to sill is generally under 25 ft.; for greater heights the trestle must be formed of two or more stories bent. The bents except in narrow canyons must be braced with longitudinal bracing. The bents should be supported on concrete footings. The footings must extend to solid rock or must be made sufficiently large to give a low bearing pressure on the foundation which is liable to become very soft from the leakage of the flume. The bearing pressure on soft ground should be not greater than 1 ton per sq. ft. The concrete footing should be connected to the sill of the bent with bolts so as to add weight to the structure in preventing overturning. The flume box is supported on the caps by means of stringers. The length of stringers or span between bents usually varies from 12 ft. to 18 ft.

THE PRACTICAL APPLICATION OF THE SELF-ADJUSTING STANDARD FOR RATE FIXING.

BY F. K. BLUE.

(Concluded.)

The previously estimated amount of sales during the fifth year, Q, is found by extrapolating a value based on the actual average sales during the previous four years. It is by no means necessary that the quantity thus estimated should be a close approximation to the actual amount finally sold during the year, because any undue losses or gains resulting from the price for the year being fixed too high or too low will be fully adjusted between the producer and the consumer by amortization during the following years. The chief desiderata in such adjustments are that the prices shall not fluctuate violently and that the consumers of one year are not unduly favored or burdened at the advantage or expense of the consumers of other years. Over a term of years the economic relations between the investors and the consumers are adjusted with striking accuracy by this method of rate fixing, but an adjustment of costs to the consumers of each year cannot be carried out with great accuracy since that would require an exact foreknowledge of uncontrollable conditions and events. The best results in this direction seem to be attained by conceiving a straight line to be drawn through a group of points plotted to represent the values for the previous years, by the method of least squares, and then taking the value indicated by the point on this line for the last year of the group as the estimated value of the quantity that will be sold during the following year. Such values are computed in the following manner:

Let Q_8 be the estimated quantity sold during the eighth year, and q_7, q_6,q_5 and q_4 be the actual quantities that were sold during the previous four years. Then for a value based on the actual values of the three previous years we will have $Q_8 = \frac{5q_7 + 2q_6 - q_5}{6}$

For the value based on the actual values of the four previous years we will have $Q_8 = \frac{7q_7 + 4q_6 + q_5 - 2q_4}{10}$

In the illustration the estimated quantity to be sold in the fifth year, $Q = 49.5$ million cu. ft., is computed in this manner from the actual quantities 50, 40, 29, and 22 million cu. ft. sold during the four previous years.

In the same manner the estimated unit cost of operation, $U = \$0.92$ per thousand cu. ft., is computed from the actual unit costs of operation \$0.96, \$1.18, \$1.42 and \$1.82 for the four previous years, and all the other values of Q and U are computed in the same manner from the actual values of q and u for the four preceding years in each instance.

The estimated cost of operation, C, is found by taking the product of the estimated unit cost of operation, U, and the estimated quantity sold Q. It is \$45,500 in the fifth year.

The estimated gross earnings required during the year, E, is the estimated required net earnings, D, plus the estimated cost of operation, C, plus the estimated required interest on outstanding bonds, plus the estimated required dividends on preferred stock, plus the sum to be set aside during the year in the depreciation fund. Preferred stock is understood to be that which is preferred as to a guaranteed dividend rate and not participating further in the profits of the enterprise. Only the net earnings and the cost of operation are accounted for in the illustration in order to avoid unnecessary complication in dealing with such other quantities that are not essential to the working out of the rate fixing method.

The estimated required price for the year is found by dividing the estimated required total gross earnings, E, by the estimated quantity sold, Q. This will be $P = E \div Q = \$1.21$ per thousand cu. ft. This indicated price being less than the preliminary price of \$1.35 is taken as the actual price to be charged for gas during the year since the gain g' for the preceding year is a positive quantity.

At the end of the year it is found that the quantity sold is 54,000,000 cu. ft. Multiplying this by the actual price we have $e = pq = \$65,300$ as the actual gross earnings during the year.

The actual cost of operation during the year is found to be \$50,000. Dividing this by the actual quantity sold we have $u = c \div q = \$0.93$ per thousand cu. ft. as the unit cost of operation.

The average value of the stock during the year is \$200,000. Dividing the indicated required dividend by this stock valuation we have $r = d \div v = 0.06$, or 6 per cent as the acceptable dividend rate on the investment as indicated by the market value of the stock.

Multiplying this by the amount of the investment for the year, we have $d' = ri = \$12,000$, as the required net earnings indicated by the market value of the stock.

In computing the gain, or loss, for the year to be amortized by an allowance in the price fixed in the following years, the cost of operation is computed from a unit cost based on the unit cost in previous years instead of the actual cost being taken. This is done in order that improvements in operation and management which result in reducing the costs of operation shall increase the returns received by the stockholders, and, on the other hand, an increase in the unit cost of production will reduce the actual income of the stockholders. This is shown in the table by a comparison of the unit cost, u, and g', the excess of actual earnings above that indicated by the market value of the stock as an acceptable return to the stockholders on their investment during the year. It will be noted that with but two exceptions a reduction in the unit cost of operation is accompanied by a surplus in the actual earnings of the stockholders and vice versa. The commensurate cost of operation, C', is accordingly computed by taking the product of the estimated unit cost of operation and the actual quantity sold; so we have $C' = Uq = \$49,700$ for the fifth year.

The total gross earnings at estimated unit cost of operation, E', is equal to this cost of production C' added to the required net earnings on investment, d', indicated by the market price of stock. So we

have the total earnings at estimated cost of operation, $E' = d' + C' = \$61,700$. As in the case of the previously estimated gross earnings, E, the estimated gross earnings, E', should in practice also include interest and dividends on bonds and preferred stock and the sum set aside in the depreciation fund, but in this case also, these items are omitted in the illustration.

The estimated excess of actual earnings above the estimated earnings based on unit cost of operation, $G' = e - E' = + \$3,600$ in the fifth year. This amount being a positive quantity represents a surplus which being subtracted from the previous deficit of $33,600 makes a total estimated deficit of $30,000 at the end of the fifth year. After the ninth year one-half of this estimated surplus, or deficit, is taken as the value of G in estimating the price for the following years:

The values e', g', s' and p' for the fifth year and thereafter are found in the same manner as already described for the first four years.

For the sixth year and thereafter the same general method of computation is followed as in the fifth year. The actual price p is taken equal to the estimated price P except that when the gain G' for the preceding year is negative the price may not be less than that of the previous year, and when the value of G' is positive the price may not be higher than that of the preceding year. This rule is not necessary but it reduces somewhat the fluctuations in price from year to year. In the seventh year it will be noted that the estimated price was computed as $1.22, but $26,000, the value of G' for the preceding year being positive, the price is kept at $1.16 as in the preceding year instead of being increased to the estimated value of $1.22. In the ninth, tenth, eleventh, twenty-sixth, twenty-ninth and thirty-first years the price is not raised to the computed amount for the same reason. In the twenty-second year the price is not reduced to the estimated value $1.01 because—$1,400, the value of G' for the preceding year, is a negative quantity. The price is not reduced to the estimated value in the twenty-fifth year for the same reason.

After the deferred dividends have been paid, which occurs at about the fourteenth year, it will be seen that under average conditions that are assumed, up to the twenty-sixth year the estimated accumulated surplus S' does not vary considerably from zero. Momentary variations caused by fluctuations in sales of operative costs are quickly liquidated by the system of perpetual amortization in price fixing. And even the persistent deficit that occurs after the twenty-sixth year would disappear if the adverse changes were halted for a year or two.

The fact that the estimated accumulated surplus or deficit S' tends always to disappear shows that on the average the economic relations between the corporation and the consumer are exactly adjusted by this method of rate fixing.

The actual accumulated surplus s' constantly increases with a constant reduction in operating costs and constantly decreases with a constant increase in operating costs, which affords the stockholders a reward for low prices and protects the consumer against excessive prices.

At the end of the twenty-sixth year it is found the price for the following year will be so high that the sales and earnings will become so small that there is apt to be a considerable deficit, g', in the actual dividend received. If this condition appears likely to continue, the investment should then be liquidated before any greater losses occur. This would be done by selling the physical property as junk or otherwise and distributing the proceeds including the depreciation fund to the stockholders. The depreciation fund should of course have been kept up so that the whole amount distributed would be just the value of the original investment of $200,000. To be exact this value should be adjusted to conform to changes in the real value of the monetary unit by which the value of the investment was originally measured; that is, except in the case of real estate, the value of the investment should conform to the cost of reproduction rather than to the original cost of the properties which it represents.

The illustration has been continued beyond the point at which a liquidation or reorganization should be effected, in order to show how the method would work in the case of increasing costs of operation and reduced sales. In practice, however, an enterprise would seldom be carried that far under such conditions.

Extensions to the plant, if adding considerably to its value, should be made by the issue of bonds or of new stock, for which there is a corresponding addition to investment valuation. Small extensions and betterments may be made by using the depreciation fund provided the physical value of the plant plus the depreciation fund be maintained equal to the value of the investment, i, which forms the basis for rate fixing.

Application of This Method of Price Fixing.

For simplicity this illustration was taken as applied to a single commodity, but with obvious modifications it can be adapted to most any enterprise in which stock can be held always for sale to the general public. It is especially applicable to the development of government resources and public utilities. Where the price of several or many articles is involved instead of one, a system of index numbers would take the place of a single price, but the method of fixing such index numbers by which the individual prices would be adjusted would be essentially the same as shown in the illustration.

Next to its use in connection with the public utilities the most important application of this method at first would perhaps be in the development of coal mines and power resources on government reservations. A grant could be made to an operating company under the stipulations that the price of all coal mined should be fixed by a government commission in accordance with this method. Any allowance for rental of lands that might be considered desirable would be added to the required earnings E, E' and e', just as if it were interest on bonds. By this method the operating company would be assured an acceptable return on its investment, and the consumer would have coal at a reasonable cost of production. There would be no risk of the government granting valuable

privileges without compensation, nor would there be a risk of government regulation which would reduce the profits below the amount acceptable to the operating company as indicated by the rate of profit that purchasers of the stock are willing to risk their money in the enterprise for.

The granting of water rights would be carried out on the same principles. An operating company would be formed to furnish the necessary capital to develop power and deliver it to customers. Such investment would form the basis on which the government would fix the price for such power. An acceptable profit on the investment would be assured since the price for any year would be fixed at a rate that would allow a dividend on the investment which would correspond to the return on the investment required by the public as indicated by the market value of the stock during the preceding year.

If it is not desirable to have the price of service fluctuate every year—as in the case of street railways—a nominal price, p, might be computed, which multiplied by the number of fares, q, would show the nominal earnings, e, which would be used in paying expenses and dividends and computing values for price fixing just as if it were actual earnings. The difference between the actual earnings and the nominal earnings would then be set aside to the credit of the municipality for the final purchase of the railway or for other purposes as desired.

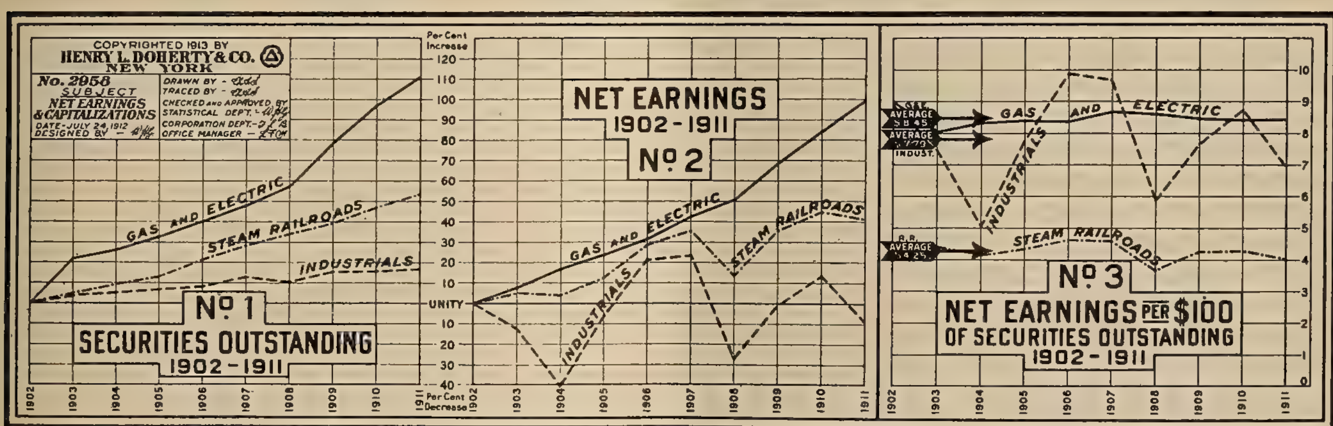
GAS AND ELECTRIC SECURITIES.

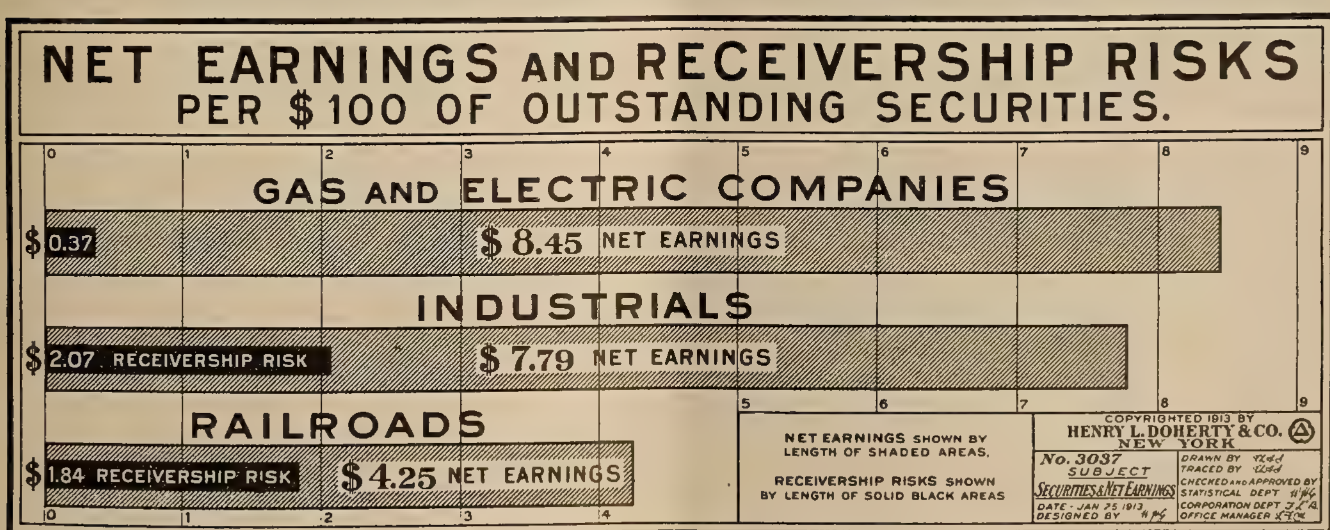
The intrinsic merits of gas and electric securities as compared with railroads and industrials is graphically illustrated in the accompanying charts prepared by Henry L. Doherty & Co.

No. 1 shows the relative increases in securities outstanding of important gas and electric, steam railroad and "industrial" companies, the figures for which were aavilable as far back as 1902.

No. 2 shows the relative increases and decreases of the net earnings of these same companies. No. 3 shows the net earnings per $100 of securities outstanding for these same groups of companies, year by year, and averaged for the 10 years. During that time they have never dropped below 8 per cent on the securities issued, in spite of the fact that these latter have increased by 110 per cent, or double the railroad expansion, is, of great interest to investors.

The remaining chart shows the average net earnings as determined from No. 3, and the average receivership risks, and illustrates the relative risks to capital. Therein it appears that for every $100 of railroad securities outstanding $1.84 averaged to be in receivers' hands. For the larger industrials this figure appears as $2.07, whereas for gas and electric securities outstanding it is but 37 cents, and this in spite of the high net earnings of these latter, amounting to an average of $8.45 per $100.





DESCRIPTION OF AN INVENTORY AND VALUATION OF A GAS AND ELECTRIC PLANT.[1]

BY H. W. CROZIER.

This paper has been prepared to describe some of the methods used in making an inventory of the gas and electric distribution systems of a company doing business in a Western city of about nine thousand inhabitants. The inventory was ordered by the State Public Utility Commission which was occupied in considering a complaint involving service and rates. Two engineers, one appointed by the commission and the other by the company, were charged with the duty of preparing the valuation.

In many of the valuations heretofore made, the quantities have been ascertained and the unit values applied directly to the original notes and the result obtained in dollars. This has been done in numerous cases where the parties making the inventory were the final authority as to the figures. In this case, however, it was expected that the valuation would be reviewed by the commission, if it should so desire or in the event that the two engineers were unable to agree.

For this reason no unit prices were applied except to the totals of the inventory and the condition of the property was reported as a percentage of its replacement value new. If any question as to the method or premises used in obtaining these percentages, corrections could then be applied in a simple manner.

Objects to be attained: The objects to be attained in the inventory and valuation were:

1st. The replacement value new of the property;

2d. The present value of the property as it stood:

3d. Maps were to be prepared and all the property of the company, as far as possible, entered thereon, and a permanent record left for future use.

4th. The results were to be so obtained as to be proven in court, and every step was to be so clearly arranged as to make it possible for an explanation to be given for every figure in the final result.

5th. All figures used for unit values or as percentages for obtaining the present value from the replacement value, were to be so calculated and carried out as to allow of simple alteration in the event that any particular item was successfully attacked.

Field parties were organized, each consisting of a chief of party, a recorder and some assistants. In some cases, one man served as both chief of party and recorder.

On the electric distribution system, the first inventory party started at the power house, and taking a line of poles followed it, numbering the poles consecutively, until a branch was encountered. The branch was then followed until completed, when the party returned to the branch junction pole, and continued on the main line. A second party inventorying copper wire, a third party inventorying service connections to the houses and a fourth party inventorying meters and checking the preceding parties, followed the same general route.

On the gas distribution system, the first party, was provided with a list of the gas consumers, arranged by streets. This party went systematically up one street and down another, inventorying gas services and gas meters, and having men whose duty it was to skirmish around houses not on the list and look for lost and capped services. The company's gas main map was carried by this party and frequently consulted.

Following the first party was a second party which listed the gas mains. A third party excavated at street intersections to determine depths, to check the company's gas map and to determine the condition of the gas mains. Except for the omission of some recent work, the company's gas map was found to be substantially correct.

The inventory parties made field notes on ruled sheets, which they numbered consecutively. These sheets were turned into the office and the data entered on a drawing for the purposes of record and as a check. The sheets were then turned over to a clerical force, totalled, summarized, and later bound as a permanent record.

Summary sheets were prepared and used to tabulate the summarized data of the field sheets and an entry was made on the summary sheets for each field sheet. Finally the summary sheets were totalled and the results transferred to the sheets bound in the final report.

The method used makes it possible to trace any item back from the final result to the original entry in the field sheet and thence to the actual property, or to trace any piece of property through the field notes and summary sheets to its location in the final result.

The poles were numbered consecutively and all material attached to them, except transformers, copper wire and arc lamps was listed in the pole field notes by the pole field party. The transformers were listed on a separate form by this same party but the copper and arc lamps were listed by another party.

All poles were examined, their length determined, the condition of the wood estimated after the butts had been tested with a prospector's pick, and, if any evidence existed near the surface of crude oil treatment, that fact was noted. The condition of the paint was estimated and all cross-arms, steps, pins, insulators, guy-wires, etc., were counted and listed.

The field party reported the condition of the poles as "Excellent," "Good," "Fair," and "Poor." To get at an average percentage figure which would represent the condition of all the poles, percentages were assigned to the poles reported by the field party after considering the following facts:

1. It is customary for electric companies to purchase as long poles as can be economically used, and, after they have been in service until the underground portion will no longer safely support them, to cut off the rotted portion and reset them. A pole originally 40 ft. long when purchased will be used successively as a 40 ft. pole, as a 35 ft. pole, as a 30 ft. pole. as a 25 ft. pole and finally outlive its usefulness as a guy-stub.

2. Continuous re-use of poles is made particularly easy by the favorable dry climate in this vicinity.

3. A pole in service, therefore, which has the butt entirely gone is considered as valuable to the company as a new pole five feet shorter.

[1]Paper presented before San Francisco Section, A. I. E. E., March 28, 1913.

Poles cost here f.o.b., as follows:

35-foot poles,	$ 8.25	82% of next larger size
40-foot poles,	10.00	75% of next larger size
45-foot poles,	13.25	87% of next larger size
50-foot poles,	15.25	90% of next larger size
55-foot poles,	17.00	
Average.......		84%

Making a small allowance for contingencies, 80 per cent of the original value was taken as the value of a pole the butt of which was so rotten as to require resetting. The pole condition was therefore rated as follows:

Field party's report,	"Excellent"	"Good"	"Fair"	"Poor"
Percentage used,	100%	95%	90%	85%

and if ready to fall down, 80 per cent (none so found.)

After the inventory was completed and the unit values were being applied to obtain the valuation, it was decided that the figure of 80 per cent used for the worst condition of a pole was too high, as sufficient allowance had not been made for the deterioration of the out-of-ground portion of the pole due to checking, pole climbing, etc., and it was decided to allow about 10 per cent for this. The deduction of about 10 per cent from the average 84 per cent reduced the final percentage from 80 to 75 per cent. It was then a very simple calculation by proportion, to change the percentages as reported in the inventory from the basis of 80 per cent to that of 75 per cent.

Painting: In working up the field notes as to condition of paint on painted poles, the following percentages were arbitrarily taken:

Field party's report,	"Excellent"	"Good"	"Fair"	"Poor"
Percentage used,	100%	75%	50%	25%

Other Materials: The cross-arms, pins, guy-wires and other attachments were found to be in very good condition. No attempt was made, therefore, to assign any percentage condition to any of these items.

Oiled Butts: It is customary in many parts of the West to pour crude oil in the holes when setting poles. The oil mixes with the earth and gravel and forms a very efficient protection for the wood. The pole inventory party dug at the base of every pole and noted the fact in their notes when oil was in evidence. The information obtained was not conclusive, however, as undoubtedly many poles, which were originally oiled, now show no evidence of that fact near the surface.

A copper inventory party listed the copper line wire, obtained its length by measuring on the ground pole to pole, and its diameter by measuring with a pair of calipers and a wire gauge. The pole numbers were recorded on the notes turned in so that it is possible to trace back any measurement from the notes to the actual wire in place.

The weather-proof wire was examined and its condition recorded. This party recorded the condition of the wire as follows: "New," "Good," "Frayed," "Badly Frayed," and "Bare." In addition it reported wire which had been originally put up as bare wire, as bare wire only.

In working up the notes each sheet was totalled and the length of each size of wire found. Percentages were then assigned to the reported condition and an average for the sheet obtained. To facilitate computation the product obtained by multiplying the length of a wire by its percentage was called the computation factor. Later in getting the average percentage of the summary sheets it was only necessary to add all the computation factors and divide by the length of the wire to obtain the average condition of all the wire under consideration.

The percentages used were based on the following facts:

1. Triple-braid weather-proof copper wire costs the same per pound as bare copper wire for all of the sizes above No. 10 wire.

2. When weather-proof insulation on copper wire has entirely disappeared there still remains the bare copper wire, which is as valuable to the company as new bare copper wire, because it can be used in places where bare copper wire would ordinarily be used.

3. It has been customary on this property to install new weather-proof wire on 2000-volt primary circuits. When this wire has deteriorated, so that it is no longer desirable to use it on the primary circuits, it is then transferred from the primary to the secondary circuits on the same poles. After putting in another period of usefulness as secondary wire, it is then taken down and used as bare wire on the outlying pumping circuits where insulated wire is not required.

Under these circumstances the total deterioration of the insulated copper wire is only from its value as new wire to the value of bare wire.

The sizes, weights per 1000 ft. and percentages used are as follows:

Size.	Wt. per 1000 ft. Weather proof.	Wt. per 1000 ft. Bare.	New.	Good.	Frayed.	Badly Frayed.	Bare.
4/0	767	639	100%	97%	93%	89%	83%
3/0	630	507	100	96	91	86	80
2/0	502	402	100	96	91	86	80
1/0	407	319	100	95	90	84	78
No. 1	316	253	100	96	91	86	80
No. 2	260	201	100	95	89	83	77
No. 4	164	126	100	95	89	83	77
No. 6	112	79	100	93	86	78	70
No. 8	75	50	100	92	84	76	67
No. 10	53	31	1000	90	80	69	58

In making the inventory, no allowance was made for sag, tie-wires, waste, losses, etc., but this allowance was made in the estimation of the proper unit value to be applied to each size of wire.

A service party followed the pole inventory party and listed the service connections from the poles to the houses. The notes made covered the condition, size and length of the wire and the number of the fixtures. In each case the pole number was noted so as to guard against omissions or duplications. In addition the party noted the arc-lamps and the wire and fixtures connected therewith. The notes turned in were turned over to the meter inventory party and the meters and fixtures inside the houses added by that party.

An electric meter party listed all the electric meters, noting the name of the maker, the size and the serial number, and also listed the copper wire and fixtures inside the houses and entered the data on the field sheets of the service party. The result aimed at was to list all the wire, fixtures, etc., up to and including the meters. This party, when necessary, turned in supplementary notes when more than one meter was found in a building and the field party had not left sufficient space on the notes.

In the office the notes turned in were totalled and the percentages assigned to the wire in the same manner as was done for the line wire. All the various fuse blocks, switches, conduit, etc., were tabulated and the meters tabulated as to maker and capacity.

A gas meter and service party visited all premises which had gas connections, and listed the meter,

noting the name of the maker, the size and the serial number; listed all pipe and fittings visible and made an estimate of the necessary pipe and fittings required to make the connection to the street mains. As in the electrical case, the result aimed at was a list of all pipe and fittings up to and including the meter.

To guide the party, a list of the gas consumers arranged by streets was furnished as well as a gas main map. They also had access to some construction report sheets which had been made during the last two years when service pipes were laid. As far as they went, the construction report sheets were a valuable guide, but in almost every case more pipe and fittings were listed on the sheets than could be accounted for on the ground. The reports turned in by this inventory party, however, recorded only such pipe, and fittings as could be accounted for and did not include any shown on the construction sheets which could not be located on the ground. Following the same method, at places where no construction sheets were available the pipe and fittings were listed.

A gas main party listed the gas mains on the sheets previously turned in by the gas service and its meter party. The location of the mains was determined from the data on the gas main map, which had been proved by excavation, from information obtained by the gas service and meter party and from measurements made on the ground. In the newer parts of the town the surveyed distances were used, but in the older parts of town all the gas mains were measured with a tape.

To determine the depth of the gas mains and the service pipes and to obtain data which could be used in estimating the excavation necessary to lay the pipes, excavations were made in about forty places in town, principally at street intersections. The depths were laid out on street profiles in the drawing room and the depths at intermediate points interpolated. The depths thus determined were entered on the report sheets and when the sheets were totalled the average depth was also put down. The final report gives the length of each size with its average depth.

The condition of the pipe was noted during the excavations as well as the character of the ground in which it was laid. From data thus obtained approximate boundary lines were drawn on the map which marked the limits of easy and hard digging, the easy digging being in earth and gravel and the hard digging in a hard cemented material.

No attempt was made to arrive at a percentage covering the condition of the gas pipe, first because the data obtained by digging was meagre and represented only a small portion of the pipe, and second because the condition was so uniformly good that it was felt it would be a waste of time.

There were, at the time of making the inventory, a number of gas and electric meters in the test rooms. These meters were listed and added to the totals of the meters found in service. As it took some time to make the inventory, it was necessary to run a check to see that no meters found in the respective test rooms had been counted in the field. To run this check the office records were consulted and all meters, both gas and electric, which had been set or removed during the time the inventory was in progress was checked up in the notes. All meters set after the inventory party had visited a house and before the test room count was made, were entered in the test room list as being in the test room on the date of the inventory. All meters removed after the inventory party had visited the premises and later found in the test room, were crossed off the test room list and left in the notes as being in service at the date of the inventory. Three electric meters were found to have been counted twice, having been removed from one location, and installed in another, while the inventory was in progress.

While the greatest care was taken to avoid omissions, it is recognized that they will occur. Duplications have been guarded against by checking one party's work by the following party's notes, and by entering the data on a map. Omissions cannot be checked this way and a percentage should properly be allowed to cover omissions.

In the determination of the unit values to be applied to the various parts of the property many authorities were consulted and the company's records used wherever possible. The company had pole prices and was doing considerable work at that time which made it possible to obtain costs of poles delivered, with freight, cartage, shaving painting, cartage to site, erection, in good detail. It was, of course, easy to obtain prices on cross arms, insulators and other items.

For the determination of unit prices for copper wire, the price of copper for the last five years was ascertained from four or five different sources and the results averaged and compared with the figures the company's books showed had been paid for copper wire which it had purchased, from which an average figure was taken representing the cost of copper wire over the period covered by the previous five years. With this figure as a basis and the company's records it was possible to make additions for reels, erection, hauling, losses, etc., and to finally assign a unit price of so much per pound for the erection of each size of wire. This unit price was applied to the quantities contained in the inventory.

Transformers, meters and arc lamps were valued on prices as at present current, but the gas pipe and gas fittings were treated somewhat similar to that of copper wire; that is, prices for some years back were averaged.

The present value of the electric distribution system was found to be 90 per cent of the replacement value new. It may be of interest to note that three engineers, after looking over the property before the inventory was made, set a figure of 90 per cent as the condition of the property and so testified before the commission.

The present value of the gas distribution system was found to be 80 per cent of the replacement value new. This lower figure was caused principally by the low value put on some of the cast iron pipe which had been used for many years.

The present value of the whole property including land, power house and distribution systems was found to be 87 per cent of the replacement value new.

DISCUSSION ON "DESCRIPTION OF AN INVENTORY AND VALUATION OF A GAS AND ELECTRIC PLANT."

Chairman (P. T. Hanscom): Mr. Crozier has given us a very commendable paper. I feel sure, however, that he has some ammunition in reserve, and I hope that in the discussion, which is now in order, the members—or any parties present—will not hesitate to tackle any angle of the subject.

Question: Was there any difference in the operations of the company between maintenance and replacement charges? I understand, in replacing copper wire you would charge it to maintenance; but was there any segregation made in operating expenses between depreciation charge or maintenance charge?

H. W. Crozier: All replacements were carried along as maintenance. Of course depreciation reserves were supposed to be carried; but the reason we worked on this theory in making the inventory was that this thing was actually going on at the time I was there.

J. T. Ryan: The value there of the depreciated condition is not entirely clear to me. Suppose you make a rough calculation. Take No. 2 weather proof wire, assuming it at 18 cents a pound, would make about $46 a thousand feet. The cost of stringing would be somewhere in the neighborhood of $4 a thousand feet; $46 for the wire and $4 for the stringing would bring up the total value of the weather proof wire in position to $50. Suppose the insulation of that wire had almost entirely disappeared and would be classed in the last column, that would give you 77 per cent of its new value.

H. W. Crozier: That is, given a certain amount of copper wire in place, and supposing the insulation badly worn, would it be properly charged, as we have done, by taking the percentage off and leaving only the bare wire. What we really did is to take 80 per cent of the replacement value, which includes the erection. We have taken 80 per cent of the erection too, so we have left in there some of the erection; but you see the erection comes out of the maintenance expense. We have got to put some more erection in to put more wire in its place. It is all taken care of in the maintenance expenses, so any particular wire in place has its erection charge in there. If we take that wire down, and put another wire in its place the erection charge will stay there. It will really go into operating expenses. If you view it that way, all the charges of taking wire down and putting it back go into operating expenses, which as a matter of renewal is correct.

S. J. Lisberger: You said something in the paper about the use of poles, about taking a 40 ft. pole, and after it had been in the ground some years, cutting off the rotten part that had been in the ground and using it as a 35 ft. pole. Do you think your figure of 80 per cent was a fair figure with such a pole?

H. W. Crozier: I think my figure of 80 would be better than 75 that the engineer in charge of valuation decided to allow. I worked that out exactly from the operations by watching the maintenance department. They were taking poles, down, hauling them off and using them again, or, cut the butt off and reset the poles as they stood. Or another scheme they had in some parts of town was to put in a new butt; (stub the poles), and in the case of a 40 ft. pole being replaced new as a 35 ft. pole they would usually only use about three feet of it, so it would really be about 37 ft. In most cases I noticed they would get a 32 ft. pole out of a 35. They were making more changes than I have allowed for, so I think this figure is more than fair.

S. J. Lisberger: It is my experience that poles reset like that have a comparatively short life. Conditions in Arizona may be different from California, owing to climate. I don't recall an old pole having been up say ten or fifteen years being good for fifteen years more after having been reset.

H. W. Crozier: That is perfectly true. In California this arrangement would not work because there would be a lot of deterioration in the top, particularly the crossarm gains. I believe there is not a pole in the whole town that the out of ground portion was not just as good as the day it was put up, except badly split, down the middle. A pole checked right down the middle I look upon as about as good as we could get. You might buy a new one, and in a year it would be that way; so a reset pole checked down the middle was just as good as a new one, assuming it was a year old. The redwood poles were much better than the cedar.

S. J. Liesberger: You spoke of inspecting the paint on the poles. How did you arrive at that? It is rather a novel point—not determining the quality of paint, but to determine the replacement value of a painted pole.

H. W. Crozier: I took the position that I did not care whether a pole was painted or not except for the appearances. I believe in that climate it does not make any particular difference. The condition of the poles in Arizona is peculiar in that they have a single split, which would be about half the diameter in depth, right down the side. You might paint all the rest of it, but I don't think it made any particular difference in the life of the pole. I regarded it entirely as a matter of appearances. We felt that a painted pole really had some protection because it would resist this cracking for a while, but not long. So the men making the inventory really rated the condition of paint by appearances. There is one thing I wanted to say in regard to painting. As far as I could see, it did not make any particular difference whether a pole was painted or not; but every time I checked up the inventory parties they would always give a higher value for a pole when there was some paint on it than they would if it wasn't painted. That is perhaps a psychological thing to keep in mind when the inventory is going to be made, that is get the paint pot busy beforehand.

J. T. Ryan: One of the most confusing things I have encountered in connection with valuation is the matter of omissions. I have always taken the stand that in inventory taken in careful detail, as Mr. Crozier has mentioned this evening, we haven't any real justification for including anything for omissions. Take for instance the Pacific Gas & Electric Company. They have 3,350,000 ft. of gas mains. If we should allow them for omissions and apply that factor it would mean 60 miles of mains. That would probably be too large a factor to use in connection with a plant of that size. I wondered if the author has made an investigation of a plant that justified the conclusions reached, or had taken his general experience.

H. W. Crozier: That is the part we were very much worried about ourselves. When we had all the work done, as I said, in the inventory count here, we found that the next party along there found four more poles. There were four more poles that they did not get—that the original party did not get, although they went over the ground, numbered every pole in town and tried to get every pole there was. Another party had to put down all the arc lamps, and had everyone of the arc lamps down, with the name of the street intersection and the whole business. We knew that we had 105 arc lamps, because we were getting paid for them, and the city had checked them up time and again. Yet this inventory party, working in detail, had missed some; and they had all the street intersections and everything.

They did the same thing on transformers, and missed some transformers absolutely, and yet they had absolutely nothing to do but to list the poles and transformers. I think the omissions on transformers—I don't remember what it was exactly, but I think it would amount to four transformers. Whether it amounted to 2 or 3 per cent of the total I don't know. I know there was one 50 kw. transformer missed.

By the use of all that data we estimated that on these items there is no question there was something like 2 or 3 per cent of omissions. We fixed these amounts of course because they were of some importance and we were able to chase those down, so when we were finally completed with our inventory we were right on them.

A. J. Bowie: When a system grows there will be a number of services and connections which will be practically useless, which, if anyone were replacing the plant, would not be replaced, but which are a natural part of the condition of growth.

H. W. Crozier: That is very true. There were a lot of old and capped services in older districts and in the adobe houses which were not used and perhaps never would be replaced. We put those all in as actual property of the company, and I suppose should have charged off something for obsolescence; but they really amounted to a very small proportion of the property, because in many cases there would be a single gas lead running to a stove, which would branch with a T, which connected two houses. Sometimes one of these would not be used, and the other would, and the small 6 or 10 ft. coming into one of the houses would perhaps be obsolete. There were other cases where the service piping would run to the back of a row of adobe houses, and there might be one of the row taking gas, and service connected to two or three of the others. Some of those little branches were obsolete, and perhaps the large size pipe going in there would be a little more than was necessary, but the total was very small.

A. J. Bowie: I refer more particularly to the mains than to the branch services.

H. W. Crozier: Regarding mains, I think that everybody felt that the gas mains were pretty small, and if anything was to be criticized about the property it was that they ought to have been larger.

W. G. Vincent: The question with regard to omissions is always a hard one to handle. Personally I do not favor making allowance for omissions because it immediately weakens the basis of your inventory. If you think there is a lot of stuff that you have missed it discredits the balance of your inventory.

I do not feel that they run as high in percentage of value as Mr. Crozier has included in his inventory, although it depends upon conditions. If you would go out and make a house to house canvass of all your gas services in the town, and look up the mains that supply all those services, how you can add 10 per cent to your mains for omissions I do not understand.

On the other hand, there is another class of omissions which should be considered, and those are the omissions which cannot be inventoried, that is, the materials necessary in the construction of a job that are not afterwards found on the job. For instance, some years ago I had occasion to check up some transmission line construction, three different jobs of about 55 miles of line; had complete records of the materials issued and charged to the job in detail, and I had inventories made in the field, counting everything in the line. In a transmission line you can see pretty nearly everything that is there. I compared the field inventory material with the actual materials that had been charged and gone to the job, and the actual material that went to the job was a little over 6 per cent in excess of what was actually found on the ground. In taking care of that we made an allowance, in valuing the transmission line, of a certain percentage of material that went into the line, and handled that as excess materials. There are odds and ends of materials taken to the job and not used. May be there is a pole left out somewhere where it does not pay to bring it in. As Mr. Crozier pointed out, they used a lot of fittings that were not necessary. I think omissions of that character should be taken as a lump sum in the unit cost.

The inventory described by Mr. Crozier is made in great detail—in fact in greater detail than most of them are made. I think the tendency is to get away from a great amount of detail, especially on small properties. The expense is burdensome; and it is usually the case—although I think conditions down there were such that they probably could not have done better—that where you have an engineer on each side working on the job, certain general assumptions and estimates can be made to cover the minor items, which will avoid the necessity of counting all of the small pieces of apparatus and equipment that go into the construction. For instance, average lengths for the service can be worked out. In the same way on the electric services and the installation of your meters, cross-arms and hardware. The pole hardware can be worked out to a unit per pole, which will be practically accurate. Some time ago in connection with that I worked up to see if it was worth while to make note of the size of each individual cross-arm in a distribution system, and I found that by taking the detail inventories of six cities, and getting an average value per single cross-arm, it averaged from $1.17 to $1.33, a variation of about 13 per cent for all sizes of arms. Now the cross-arms run about 5 or 6 per cent of the total value of your overhead distribution system; so if you miss your estimate on the value of the arm by 13 per cent it would make a difference of .8 or 1 per cent on the value of the distribution system. That is a pretty small error. So I think the tendency will be to get away from the great detail, and to generalize more and more on those general items.

The question of the poles that Mr. Crozier spoke of is rather an unusual one, and we do not find any such conditions in California.

J. T. Ryan: One of the factors in the paper that has appealed to me more strongly than anything else was the very comfortable factor of time that was apparently permitted. It is the usual experience in matters of valuation that the appraisement is never decided upon except as a last resort—something on the principle of a surgical operation —and is only authorized when the necessity for it has become exceedingly acute. When the question is asked, "How soon is the report desired?" the usual answer in my experience has been "Yesterday"; and I have never had such a comfortable factor of time in a valuation that I have been associated with as the author apparently had. That acts as a greater determent to taking the inventory in detail than any other one thing, because when the appraisal is decided on it is usually accompanied with such urgent need for the final result that it makes it necessary to eliminate all unnecessary detail, and sometimes cuts the factor of time for mature deliberation on points that sometimes we found later it was necessary to go over and do work again.

I have found, though, that it is possible to get accurate field data on quantities of some variety of material without even taking field notes of them. For example, in the matters of insulators and pins on the pole line they can be assumed within a very close limit of accuracy from the number of spans of wire, plus the number of double cross-arms; and very often it is the case that the inventory is burdened with an immense amount of detail that tends to confuse and hide some more important elements of the value. I had in mind the fact that after a very careful computation of the age and physical condition and observed depreciation made in the inventory, it only justified in the end estimates made previously by engineers of the actual conditions of the property.

Of course in making an appraisal that is designed to stand the cross-fire of conflicting interests in a rate case it is necessary to make provisions that will not be necessary for some other cases of appraisal, which would be satisfied with something less elaborate.

THE POSSIBLE FAILURE OF WELL IRRIGATION IN THE SAN JOAQUIN VALLEY.

BY A. L. COLLINS.[1]

The amount of water in the ground available at any time for irrigation is (1) the water stored in the earth and accumulated during the past ages, (2) and the water that flows into the ground each year and is lost by seepage and evaporation. The latter amount is the perpetual water supply, and any demand beyond this will encroach upon the storage supply.

It must be recognized by all that there is a reasonable limit to the amount of water that can profitably be taken from the ground.

If we do not believe that the amount of water is limited, we must forget the better known laws of nature and treat the existence of the ground water as a special act of Providence.

In this article regarding the San Joaquin Valley the questions are asked:

(1) Does the ground contain sufficient water for a perpetual standard irrigation supply?

(2) Is the rainfall sufficient to fill up and maintain the ground water levels, showing that the sand strata are fully replenished each year?

(3) Can the rivers, only in very exceptional cases, be depended upon to replenish the exhausted water sands?

(4) Can the rainfall and resulting seepage from the mountains be depended upon to replenish the valley sands and gravels?

(5) Is the common type of irrigation well and plant now considered permanent, but temporary?

The negative side of these questions is discussed here, hoping that criticism will be made by people best qualified to answer, and who are almost certain to take the affirmative.

The failure of the underground water supply means the lowering of the water in the well until the cost of pumping absorbs the profits of the crops. Such a failure does not necessarily mean that the land that has been developed will become a barren desert, but it does mean that the community will be disappointed and that only the more fortunate will be contented.

To get the proper conception of the existence of the ground water supply, in the San Joaquin Valley, we must forget the impressions of our childhood days, such as the wonders of the mammoth caves and the spouting geysers, and use the every-day examples of nature as a basis for our reasoning, rather than the exceptions and freaks.

To the uninitiated, a moist earth plot a few feet square, with a green covering of grass, is accepted as an indication of "an inexhaustible water supply."

In the interior valleys of California, it must be recognized that water is a necessity for profitable crops, and for the success of the valley.

The experiments carried on by the agricultural experimenters, and the experience of the water companies, would indicate that there is almost a standard amount of water required by each crop. Of course, the results are varied, depending upon the type of soil and other conditions.

It is the consensus of opinion that alfalfa should have from 1½ ft. to 3 ft. depth of water applied by man during the season. Now there are patches of alfalfa on the richer sediment soils that will yield from 3 to 5 tons without irrigation, but with the aid of irrigation, will increase the yield to 10 tons.

With few exceptions, the fruit must also have water. This is not saying that the trees will not produce something with proper care, but a farmer is going to be seriously handicapped in making even a living if he insists on dry farming.

There should be applied from 1 ft. to 1½ ft. of water for ordinary fruits.

It should be noted here that while the experiments show that amounts varying from 1½ to 3 ft. deep are applied in certain districts for crops, it is not unusual to apply even 10 feet.

In considering an irrigation system that will use ground waters exclusively, there are two facts which everybody should know, namely: The water supply must originate from the rains, and that the water when in the ground can be pumped only from the clean porous sands or gravel as from a lake. A moist clay or heavy soil contains moisture, but the process of seepage passing to the sands from the clays is a very slow process and is uncertain.

Water for irrigation, if taken from wells, must be supplied originally from (1) the local rainfall percolating through the upper strata; (2) the water percolating into the sands from the rivers, or (3) the water percolating from the mountains by underground channels.

To assist in discussing the statement that the rainfall is insufficient to provide continuous irrigation, the complete rainfall records for the past forty or fifty years of the valley are available, as published by the United States Weather Bureau. By taking the rainfall records of the whole San Joaquin Valley, which includes an area of 250 miles by 50 miles, and using the stations that are not over 500 feet above sea level, the average rainfall is less than 13 inches and the maximum of any one station for any one year is less than 20 inches.

Distribution of the Rain.

There are four sources of distribution for the precipitation, namely: the evaporation, that consumed by plants, the seepage, and run-off.

The evaporation from a water surface, as in a lake, in the San Joaquin Valley, is found to be about 4½ feet for the season. The following table will give an idea of distribution of the evaporation, and the rainfall:

Month.	Inches of Evaporation. (if available.)	Inches of Rain.
September	2.1	0.2
October	1.2	0.7
November	1.0	1.5
December	2.2	2.1
January	2.6	1.8
February	3.0	1.8
March	5.0	1.8
April	7.5	1.8
May	9.2	0.6
June	9.5	0.3
July	7.0	...
August	3.7	...
	54.0	12.6

[1]Consulting Engineer on Power and Irrigation, 112 Market Street, San Francisco.

Experience shows that at least 5 inches of rainfall must fall in a comparatively short time before the soils will permit the water to flow into the drains. This water coming after the intensely hot summers, during which time the ground is thoroughly dried out for several feet down, will be held in suspension and gradually distributed to varying depths. It is known fact that capillary attraction causes the moisture to move towards the surface, which is contrary to the generally accepted theory of fast percolating waters.

In view of the small amount of rain and the large evaporation, and the fact that a well-distributed 13 inches of rain only soaks up the ground for a few feet, should make it evident that the seepage from rainfall in large amounts is uncertain.

It is known that the porous or sandy soils are capable of absorbing large amounts of water, but even then the experience with water standing in ponds and canals with the best soil conditions for seepage and where water is in contact with the banks, should indicate to everybody who has had experience the slowness with which water is absorbed by the soils.

It has been found that in certain parts of the Sacramento Valley there are conditions similar to the San Joaquin, with the exception that there is more rain. About October the ground waters gradually rise as much as 6 inches. The theory by some people is that the winter rains have just reached the permanent ground water strata.

This rise occurs at the end of the dry season and at a time when evaporation is decreasing rapidly. At the same time, the streams rise a few inches, from their head waters to the tides. This would indicate that the rise might be due to either the past winter floods or the decrease in evaporation, or both.

This 6 inch rise means, if we assume the porosity of the soils to be 25 per cent, that a sheet of water only 1½ inches deep has appeared in the lower soils. If the water comes from soils of only 10 per cent porosity, the sheet of water is only 0.6 of an inch in depth.

It would appear that the ground water is fed from below and that the increase in the upward velocity is due to capillary attraction and the rapid evaporation and drying out of the ground during the summer months, and that this under seepage, by its slow movement, is unable to keep up until this season of the year.

The movement of the water can only be the equalizing of the waters distributed at some previous periods of long or short duration.

It should be apparent that this 6 inch raise is only the fluctuation of a sheet of water (even if it is distributed uniformally over the valley) of about one inch, as it would be applied for irrigation.

Assuming that we should have an irrigation of 18 inches in depth to apply on the soil, we have no chance. under these conditions of obtaining the water from the rainfall, to store below the soil.

Seepage from the Rivers.

The time has not arrived in the San Joaquin Valley when it can be stated that rivers furnish the water to the surrounding lands by percolation. The ground water levels nearly everywhere are far above the water in the streams. Now, before the streams can feed an exhausted locality, the water in the well must be lowered to cause the water to flow in a downhill direction, from the stream to the pumping plant. We are further confronted with the uncertain amount of seepage coming from the river, even under the most favorable downgrade conditions. Rivers carrying silt have a tendency to seal up the porous sands. If we will imagine a large sand channel and assume that the sand is of such size as to be favorable for the transmtssion of the largest amount of water with the least fall, nearly everybody will change their conception of the amount of water that sands can transmit.

The United States Government in the last fifteen years has made extensive experiments regarding the velocity of underground water, and reference is made to Bulletin No. 43, by C. S. Slichter. Nearly all the experiments were made in the bed of old streams of uniform sand strata and a similar attempt in the San Joaquin Valley would be impractical, since the strata is very uneven and has very little fall. However, to obtain an idea as to the amount of water that could be transmitted in a sand strata, reference is made to the bulletin. The sands in the valley are nearly all fine, and if we select a sand for an example, as would occur only in the most favored districts, in the San Joaquin Valley, we could not expect the water to attain a velocity of over 10 feet per day, with a fall away from the rtver of 15 feet per mile. Now, assuming that there is a sand bank adjoining a river and that the fall is 15 feet to the mile away from the river, it will take the water almost two years to sweep back one mile and a half. The amount of water then flowing from the river into a layer of sand 10 feet thick, and one mile long, adjoining the river, and assuming that the air space in the sand is 33 1/3 per cent water area, and that the grade is 15 feet per mile, will supply just about enough water for the continuous operation of a 6 inch pump giving 900 gallons per minute.

This sized installation is very common throughout the valley and is more common than exceptional.

It is readily seen that if the banks open into suitable sand strata and that the water in the wells are lowered below the river, there will be a comparatively small flow in that direction. However, one would naturally expect that the sand strata would rise in grade from the river, which would make the reverse of the grade that is necessary.

Practically speaking, the pumping plants as now constructed a few miles back from the river must depend upon the upper foothill flow of the sands until the water recedes in the well a considerable depth, and then it will be neecssary to decrease the capacity of the pump so as to just consume the water that will pass through the sands, otherwise the pump will have to operate intermittantly.

Mountain Seepage Supply.

In considering the mountain seepage supply, it is hard to imagine underground water channels, reaching to the San Joaquin Valley, except through the river passes. We must imagine the water seeping through the rocks, passing under canyons of comparatively low elevations (acting as drains) to appear in the basins of the valley.

Wells that are made adjacent to the foothills more frequently strike clay beds several hundred feet thick, and one would reasonably expect that the clay beds are the tops of hills. One is justified only in saying

that the water that reaches the valleys seeps through the same passes that the surface water uses.

If nature is so generous with water channels extending so many miles under the mountains, it only seems probable that there should be evidences of seepage along the foothills where man could see it.

Does mining operations give evidence that such passages exist as to feed the water into the valleys in large enough quantities to furnish the demands?

Between the valley proper and the mountains there are miles of foothills. Like the mountains, they are steep and any excess of water runs off. The soils are heavy and impervious to water. Only a small percentage of the sub-strata is capable of storing water. Can we depend only upon perhaps small crevices between the two adjacent slopes to store water and furnish the required amounts? The conditions here are not like sections of the United States countries, as in the Middle West, where the same geological formations exist uniformally for hundreds of miles and for a great many miles form immense reservoirs.

We should conclude the waters would have to follow a very non-uniform course and we would have to trust to the thoughtfulness of nature to make the conditions possible.

The Chief Source of Supply for the Ground Waters.

The source of supply upon which the ground water must depend for replenishment reaches the valley from the mountain streams, and at a time after they pass the canyon opening directly into the valley.

The United States Water Supply Paper 220 on the ground waters of the San Joaquin Valley describes the mountain streams as entering the valley through canyons and spreading out in smaller streams taking fan-like directions. The ground water elevation adjacent to these fans have an elevation above the surrounding lands, which is an indication that these streams are the sources of supply. In past years the water has been distributed over these fans and has distributed the present water supply.

With the activities of irrigation during the last fifty years, the summer flows of all these streams are practically all diverted and the water is taken from the main channel and put upon the lands to be wholly used up by the crops. The supply of water for seepage is then limited to the periods of the floods of a few months duration. The amount of water that will percolate into the ground cannot be proportional to the intensity of the flood nor the annual run-off in inches.

The time is not far distant when reservoirs in the mountains will retain most of the flood waters and then even this opportunity for the ground water replenishment will be at an end.

Since the activities of man the source of the ground water supply has been half closed and it is only a question of time until the supply of water accumulated in past seasons and now so abundant will decrease.

Pumping Plants Are Only Temporarily Constructed.

In considering the statement that the common pumping plants are of temporary nature, it is of importance to consider the types and classes of wells and the conditions encountered.

Wells as deep as 2000 feet in the valley basin show the existence of a basin filled in by the adjacent slides and washes from the mountains. The heavy soils, and the sand strata, are generally saturated and the water will stand only a few feet from the surface of the ground. However, it is evident that a great many of the sand strata are only pockets and that they are either dry or the water is dormant, as in a lake.

In putting down two wells 10 feet apart, there is no assurance that the "logs" will be the same. In most cases, however, this same strata is encountered, but it will vary from mere traces to any amount. On the other hand, in placing two wells even a quarter of a mile apart, one well is very likely to lower the water in the other.

It is quite common, again, to put two wells close together, one, say, 100 feet deep, and the other 200 feet deep, one well pumping from the shallow strata and the other from the lower, both independent of each other.

Now, the amount of idle water, if we may term it such, in the sub-soil, can be estimated in a general way. A man putting down a well 200 feet should be satisfied if he can find 20 feet of water bearing clean sands. Assuming that the water space between the sand particles is 33 1/3 per cent, we have a total depth of 6 1/3 feet of clear water.

In order to get out this 6 1/3 feet of water, it will be necessary to exhaust the water from the sands for the total depth of the well, if there is not a general circulation of the water from the surrounding country. Of course, the heavy clays will contain water, but it cannot be expected that they will give up their water only as a slow seepage process.

We have then the two classes of "stove pipe" wells, the shallow wells, about 250 feet deep, and the deep wells, some of them reaching to a 2000-foot depth.

The question is asked, where does the artesian water supply come from? In drilling a 1000-foot well, several artesian flows may be encountered. To have an artesian supply there must be confining layers of clay, hard pan or rock, between which the water is confined under pressure. In drilling a well it frequently happens that each time an artesian strata is encountered, when there are several in the well, the water will rise a certain height, showing that it is under a pressure, and the deeper you go the higher the water rises. This pressure is either due to the water coming from a higher level, several miles away, or from some unknown cause.

It is nearly always asumed without further questioning, that the artesian water is furnished by a stream feeding into the valley at an altitude higher than the outlet of the artesian well and that the supply at the well is inexhaustible.

It is the history of nearly every artesian belt to decrease the flow in time. An artesian well of 50 miners inches continuous flow is a fair well. This well flowing for one year will discharge enough water to cover 8 city blocks (250 feet by 350 feet, containtng two acres) with water to a depth of 46 feet. Assuming that the water must come from sand of which 33 1/3 per cent is water space only, the amount of sand drained

will make a pile that will cover 24 city blocks 46 feet deep.

We have no assurance that the pressure of the water is not the result of the pressure of the loose materials in the valleys, having pushed the impervious clay beds down at some previous period, as could be done by earthquakes, and thus forcing the water back to a higher level, causing a hydraulic pressure, since water is incompressible. We may consider, if we so choose, that the pressure is caused by the slowly accumulated water, at the higher level and that the supply now at hand is not perpetual and in view of the decreasing flaws is not being fully replenished, although there may be a scientific explanation for the lowering of the water in a well without admitting that the supply is diminishing.

In certain sections there is often gas with the water, showing that there has been some kind of a subterranean chemical action which puts the water under pressure.

This discussion of an artesian well brings out the importance of conserving the supply and if we cannot be convinced that the supply is limited, we should at least be skeptical.

Should we but consider these ground waters but dormant, and having been accumulated slowly during the ages? In the artesian wells, we should be surprised only that they are so permanent. Since nearly every artesian well district has apparently a gradually decreasing flow, it is just as reasonable to assume that the well is draining an extensive sand bed of dormant water under pressure, and that it is not continuously replenished nor inexhaustible.

There is a condition that exists in the valley regarding the very short time that is sometimes required for one well to influence another. In view of the impossibility of water attaining any great velocity in the finer sands there must be some unusual conditions in connection with these ground water supplies.

The log of a well will show various strata of hard clay, packed and almost cemented sand, then the loose beach sands, and the sands so finely divided termed quick sands. It is sometimes maintained that the quick sands which is so finely divided and which is so easily suspended in water, may open up a small water space, with the compact clay acting as a roof. The water space may have a fraction of an inch or more of free space a few feet across but in that way provide a rapid means for equalizing the ground waters.

There is however a scientific reason for the sympathetic and rapid fluctuation of the water in a well. The discussion involves the discourse on the equalizing of pressures of an incompressible fluid in a large receptacle with small openings. It is sufficient to say that wells, both artesian and shallow wells, may, in special cases, lower several feet and at the same time the lowering is not the result of an insufficient water supply in the ground but is the equalizing of pressures. This condition is frequently brought about by the activity of a neighboring supply tapping the same basin.

The following statement is an illustration of the large amount of water that is ordinarily pumped with a 6 inch centrifugal pump, giving 900 gallons per minute. It is assumed that the water bearing strata contains 33 1/3 per cent water. The pump operating for 6 continuous months (the irrigation season) will drain a sand pile 46 ft. high, covering 24 city blocks 250 ft. x 350 ft. each, (an area of 2 acres).

Carrying the example farther and assuming that there is only 20 ft. of sand in a depth of 100 ft. of earth this pump will drain a volume of ground that would cover 120 city blocks (250 ft. x 350 ft. each) 46 ft. high, in furnishing water enough for the irrigation of 240 acres of alfalfa, using a 36 in. depth of water.

As stated previously this size of pump is common. The continuous yearly irrigation will no doubt cause a quantity of the water to percolate back in the ground to be used again. But when it is considered that the dependable good water strata is generally down 75 ft. or more, it should be recognized that the sudden starting of irrigation will very likely deplete the lower strata before the surface water can saturate the upper soils and feed to the lower. With the intensely hot summers, and the large evaporation amounting to some times ¼ of an in. a day at a time when the water is applied and the retention of the water by the upper soil it is not reasonable to expect that only an appreciable amount of moisture will percolate to the live sand beds, from the surface irrigation.

The districts where such depths at 6 ft. or more of water is applied in a season (which indicates that the soil is of sandy type) the ground waters stand a chance of being replenished since we are feeding water into the same type of strata as from which we are depending upon our grand water supply. This condition would only exist however where there is a supply of water taken from the rivers and not the ground.

The success of a well depends upon the luck of not only the finding of the water sand, but the selection of a well driller who can make a satisfactory well and in addition the inactivities of the neighbor's plant.

Now if the contentions of this article are correct. and they are based upon the experience throughout the valley, then the common type of pumping plant will have to be replaced by practically a new plant in order to pump under the conditions of the changing water levels. The cost for pumping will increase and the amount of water will decrease as the water levels lower.

The development of a country must depend upon the speculative instinct of the people. Their agents, the real-estate people, the power companies, and boosters are in nearly every case sincere as far as their intentions and information goes, but it may be discovered at a later date that their first efforts were based upon ignorance and a misconception of the ordinary physical laws of nature, and that they had placed their hopes too high.

It is not the intention in this article to claim that the successful well installations are an exception to the rule, nor that the water will be entirely exhausted, nor to discredit the fact that the individual well installations at the present time are a paying investment. The water in any amount, will add to the value of the land, but the public should be informed as to what they should expect in the future and if there is a limited water supply, to make it known that the amount

is limited and that an effort should always be made to put in the most economical plant and to assist in developing storage reservoirs for conserving the flood waters, in the mountains for the continuance of their best interests.

The outcome of the colonization schemes will be first an increase of acreage as today and continuing for an indefinite time, then followed by the water in the wells falling rapidly which fact will probably be attributed to dry years. There will then be the survival of the fittest and the monopolist will use a minimum of water and sell the rest to his unfortunate neighbor. The company or individual today who has foresight enough to see that his well development is based on conservative lines, can control the water supply of the community.

ELECTRIC PLANTS IN ARGENTINA.

Electric light will shortly be installed in the suburb of Caseros.

In May next work will be commenced on the electric light station estacion Cruz, Cordoba.

J. G. White & Company, concessionaries for electric tramways in the city of Santa Fe, have passed same over to the Argentine Tramway & Electric Power Company, they remaining as guarantors that the work will be carried out. Material is arriving, and the work will shortly be pushed.

The Hydroelectric Company of Tucuman has offered to the municipality of that city to undertake the entire illumination at a reduction of 12 per cent on the actual amount now paid to the Cia. Electrica del Norte. It would mean a reduction in the public lighting bill of $500 monthly.

Work has been commenced on the building for the electric power house at General Pico (Pampa).

A GENERAL SUMMARY OF IRRIGATION IN THE UNITED STATES.

The table which follows summarizes the principal data for the arid region as a whole as returned at the census of 1910; unless otherwise indicated the figures relate to the year in which the census was taken. The general agricultural statistics given for purposes of comparison cover the entire areas of the states included in the "arid region," although in some of the states the territory which requires no irrigation vastly exceeds the irrigated lands. The number of farms irrigated is the number of farms on which irrigation is practiced, regardless of the extent of such irrigation. The acreage irrigated in 1909 is that reported by the special agents from information secured from owners or officials of irrigation enterprises or, in some instances, from public records. This acreage is probably in some measure an overstatement; it is believed, however, that the acreage given is within 10 per cent of the correct figure. In addition to information as to the acreage irrigated in 1909 data were collected as to the acreage the enterprises were capable of supplying with water in 1910 and the total acreage which enterprises completed or under way in 1910 were designed to supply ultimately (designated as "acreage included in projects").

	Census of 1910
Number of farms[1]	1,440,822
Approximate land area[1]—acres	1,161,385,600
Land in farms[1]—acres	388,606,991
Improved land in farms[1]—acres	173,433,957
Number of farms irrigated[2]	158,713
Acreage irrigated[2]	13,738,485
Acreage enterprises were capable of irrigating	19,334,697
Acreage included in projects	31,111,142
Number of enterprises	54,700
Total length of ditches—miles	125,591
Length of main ditches—miles	87,529
Length of lateral ditches—miles	38,062
Number of flowing wells	5,070
Number of reservoirs	6,812
Capacity of reservoirs—acre-ft	12,581,129
Number of pumped wells	14,558
Number of pumping plants	13,906
Capacity of power plants—horsepower	243,435
Acreage irrigated with pumped water[2]	477,625
Acreage irrigated from flowing wells[2]	144,400
Cost of irrigation enterprises	$307,866,369
Average cost per acre[3]	$15.92
Average cost of operation and maintenance, per acre[2]	$1.07

[1] Figures relate to entire areas of states in the arid region.

[2] In 1909.

[3] Based on cost to July 1, 1910, and acreage enterprises were capable of irrigating in 1910.

The total acreage irrigated in 1909 may be thus classified by sources of the water supply: From streams—by gravity, 12,763,979 acres, by pumping 157,775 acres; from wells—flowing 144,400 acres, by pumping 307,496 acres; from reservoirs, 98,193 acres; from lakes—by gravity 58,284 acres, by pumping 12,354 acres; from springs, 196,186 acres; total acreage irrigated, 13,738,485; total acreage irrigated with pumped water, 477,625. More than nine-tenths (92.9 per cent) of the acreage irrigated in 1909 was supplied with water by gravity diversion from streams, and, including cases where water was pumped, streams constituted the source of supply for 94.1 per cent of the total acreage irrigated. Wells supplied the next largest acreage, 3.3 per cent of the total, about one-third of this acreage being watered by flowing wells. Springs furnished the supply for 1.4 per cent of the total acreage irrigated, and reservoirs and lakes each for less than 1 per cent. Of the total acreage irrigated from wells, California contained 77.6 per cent and New Mexico 12.1 per cent. In the case of the other sources of supply the acreage irrigated was more generally distributed among the states.

Size and Cost of Various Enterprises.

The magnitude of the various irrigation enterprises, by general classes, appears below, the schedule also showing the average cost per acre:

Class of enterprise.	Acreage irrigated in 1909.	Acreage enterprises were capable of irrigating in 1910.	Acreage included in projects.	Average cost of irrigation enterprises per acre. Based on cost to July 1, 1910, and acreage capable of irrigation in 1910.	Based on cost to July 1, 1910, and acreage irrigated in 1909.	Based on estimated final cost and acreage included in projects.
U. S. Reclamation Service	395,646	786,190	1,973,016	$67.52	$134.17	$48.14
U. S. Indian Service	172,912	376,576	879,068	12.78	27.83	13.33
Carey Act enterprises	288,553	1,089,677	2,573,874	30.53	115.30	21.75
Irrigation districts	528,642	800,451	1,581,465	27.37	41.44	20.33
Cooperative enterprises	4,643,539	6,191,577	8,830,197	12.89	17.19	10.07
Individual and partnership enterprises	6,257,387	7,666,110	10,153,545	7.09	8.69	5.22
Commercial enterprises	1,451,806	2,424,116	5,119,977	24.98	41.71	16.79
Total	13,738,485	19,334,697	31,111,142	.....	.....	.....

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CONTENTS

Self-Adjusting Rate Fixing

Wildcat ventures are too recent in their exit in the West to need any detail words of warning looking toward avoiding their possible reappearance in our commercial and financial activities. The adventurous life and habits of the "forty-niner" unquestionably had their effect upon the succeeding generation in creating, for many years, a gambling spirit which largely pervaded many of our Western enterprises. The wholesale manner in which stocks were issued for mining, irrigation, power and agricultural projects often running in the millions with no—or scarcely any—tangible assets forcefully bear witness to this fact.

In this second day of serious reflection, the question of giving any money or par value to stocks is often raised. For instance, many urge simply enumerating the total number of shares comprising the corporation without assigning any value to it save its current market price.

It would seem, however, since regulation of public utilities has definitely established the fact that any utility is entitled to a reasonable return on the actual money invested, that the best method of treatment in the final analysis would be to allow such corporations to issue stock to actually represent the capital invested.

In our numbers of November 28, 1912, December 7, 1912, and the two most recent issues, F. K. Blue has set forth a remarkable scheme for a self-adjusting standard for rate-fixing. Under this proposed method the price of the product of a utility is based on the market price of stock during the preceding year. At first glance this seems wholly unjustifiable in that abnormal stock valuations would at once ensue, yet, by carefully following Mr. Blue's arguments, it is seen that what actually will happen is that the stock will automatically lower in price to its proper level or else the purchaser must accept a lower return on his money.

The practical application of such a scheme offers simplicity in every detail. The rates are automatically adjusted by taking into account the amount of money actually invested, the quantity of the product sold, the cost of operation and the average market price of the stock—all matters of positive record.

Under the present systems of commission regulation, a misrepresentation or an error may bring about undue returns to a utility or, on the other hand, a loss may actually be sustained without remedy. Under the proposed scheme, however, surpluses and deficiencies, year by year, are amortized out over a series of years and perfect automatic readjustment thus follows.

It is of course to be seen that such a proposal virtually guarantees a reasonable return on utility investment. But since the tendency of the times is to prevent any greater returns than a reasonable rate of interest, such a guarantee on the part of the consuming public is only just and reasonable.

The detailed illustration on this subject concluded in this issue is worthy of careful consideration by all rate-fixing bodies.

The Possible Failure of Well Irrigation

The transition period from the old West to the new has been brief but effective. Many are prone to question whether even the great works of the Almighty may not be materially affected by the Herculean tasks of the age. The construction of giant sky-scrapers, the demolishing of huge mountains, the changing of the ocean currents, and the creation of vast eddies in the atmosphere due to untold heat units emitted from the industries must surely have some tendency to unbalance the natural creation of the great architect.

The contemplation of such thoughts as these has lead many noted scientists to compute the period at which the supply of certain natural resources may be reasonably expected to play out. First came the cry of the timber conservationist, then the coal-ceasing-period computer and lastly that of him who fears a ceasing of our underground waters.

Like the early days of gravity systems of irrigation in the West, well-pumping may, if not safely and scientifically directed, end in many heart-breaking disasters. While data to extreme refinement have never been gathered regarding the underground waters of the West, still enough is of record to show the remarkable results that may be obtained. In Southern California about 200 second feet of underground waters had been developed up to 1907 and this volume irrigated about 125,000 acres. While the duty of water in the San Joaquin valley and other productive sections of the West, due to varying crops there prevailing can never probably be as high as in Southern California, nevertheless on the same basis of computation wonderful potential possibilities may be shown. As pointed out by B. A. Etcheverry before the Commonwealth Club of San Francisco, authorities of the United States Geological Survey place the present volume of ground waters used in the San Joaquin valley at 300 second feet and estimate a total available supply of 3000 second feet. This would then be sufficient to irrigate 1,900,000 acres of land. The present area under irrigation in the San Joaquin valley is 2,150,000 acres, and the total estimated arable area is 7,500,000 acres.

The total mean annual flow of the main streams of this valley totals 12,122,400 acre feet and if entirely bottled up and consumed for scientific application would cover the entire arable area to a depth of 20 inches. The gorges and canyons of the Sierras teem with possible reservoir sites. Hence in the ultimate development of this fertile valley by storage and pumping the former will materially aid the latter, for 30 per cent of these stored waters will again find a reservoir haven for man's use in the great underground channels of the earth. So useful and pliable has this underground storage been found that the waters of the Santa Ana River in Southern California during the flood period are annually disgorged over an enormous area and again pumped to surface for irrigation during the proper season.

Many instances are of record in the West where the underground water table is actually raising each year. Indeed careful governmental experiments show that at least 30 per cent of the water used in irrigation returns again to replenish this supply. The data quoted from the Sacramento valley in the article referred to in which it is attempted to show that the water table is replenished annually only six inches in depth is far from complete. Who can say but that a slight lowering of this water level by pumping may not possibly divert countless other underground streams to this diminishing area? Again, did not engineers for twenty-five years compute to a nicety the time when the great Salt Lake would grow dry, for it was observed to lessen in height by a constant amount each year? To look at the waters of this lake this year which are even now almost splashing over the rails of the Lucin cut-off, is to warn the engineer to be conservative and forget not the cycles of repetition that may be at work, yet unknown at present.

The veritable thousands of obstacles that have been overcome in the West, many of which were accomplished in the face of precedent and hitherto established reasoning, make us all bare our heads in solemn reverence for the unfailing provision that has been made for our Western needs and happily to chant the old proverb of Confucious:

"The stork has long legs,
The duck has short legs,
The stork cannot make his legs short,
The duck cannot make his legs long.

Why worry?"

The Saving of Water

Our readers are familiar with the Utah plant that pumps a portion of its power-developing waters in order to drop a neighboring stream through the water wheels and thereby utilize a portion of the energy which would otherwise go to waste. Our leading article of this issue presents another interesting phase of the methods made use of in the West in the recovery of power which would otherwise go to waste. The municipal water system of Seattle has an intermediate service reservoir, the overflow from which ts 412 ft. above Lake Union. As there is available approximately 60 second-feet of water from this source, the power recovered which would otherwise be wasted foots the neat total of 1500 kw. at the switchboard.

This installation at Seattle is not only interesting in its actual physical make-up but especially so when considered as one of the many possibilities that may be taken advantage of in municipal and community growth for the development of power. It is true that often such sources of water supply must be intermittent in character. Such powers, due to the headworks and other constructive features being already available, may as a rule be developed at a remarkably low figure per horsepower installed and if run in conjunction with a steam auxiliary as is contemplated at Seattle maximum continuity of service is easily attainable.

The lesson is a forceful one, then, and Western engineers should be alert in ferreting out other possibilities of this nature. Thus is true conservation most easily acquired.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Samuel Hill of Maryhill, Wash., good road advocate and telephone official, is at San Francisco.

Wynn Meredith, of Sanderson & Porter, has returned to his San Francisco offices from Vancouver, B. C.

F. H. Leggatt, Pacific Coast district manager for the Western Electric Company, is at Hot Springs, Va.

E. K. Wilde, superintendent of the Australian Gas Company, at Sydney, Australia, is visiting California.

H. B. Squires, manufacturers' representative, with headquarters at San Francisco, is in Southern California.

C. H. Johnson, pole specialist with the Western Electric Company, has returned to San Francisco from the Northwest.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, has returned to his San Francisco offices from Los Angeles.

A. M. Dickinson, representing Hubbard & Co. lines with the Pacific States Electric Company, has resigned to enter into business for himself.

Joseph Jacobs, consulting engineer at Seattle, delivered an address on "Engineering as a Profession" at the University of Washington, April 23rd.

E. L. Barnes, district manager for the American District Steam Company, has opened new Pacific Coast offices in the Hoge Building Seattle, Wash.

J. D. Ross, superintendent of the Seattle municipal plant, delivered a lecture at Seattle on April 29, on "The Best Lighting Plant in the World."

A. V. Olson, formerly with the Fobes Supply Company at Seattle, is now with Pass & Seymour's Pacific Coast office with headquarters at San Francisco.

Henry T. Scott, chairman of the executive board of the Pacific Telegraph and Telephone Company, has returned to San Francisco from a three weeks' visit to New York and other points.

J. B. Stannard, consulting engineer, has returned to his office in the Henry Building, Portland, after conferring with the municipal authorities at Baker City, Oregon, regarding plans for a lighting plant.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, has removed his San Francisco offices from 88 First street, to the Aronson Building, on Third street, near Market.

J. J. Gorman has been elected president of the Manhattan Electrical Supply Company to fill the vacancy caused by the death of **H. T. Johnson. B. H. Ellis**, treasurer of the company, was also elected vice-president.

Frank E. Watts, reigning Jupiter of the Jovian Order, has resigned as manager of the Sunbeam lamp department of the Western Electric Company to join the advertising staff of the Electrical World of New York City.

D. W. Standrod, jurist and capitalist at Pocatello; **John A. Blomquist**, Boise, and **Alex. P. Ramstedt**, banker, at Moscow, have been appointed members of the newly created Idaho Public Utilities Commission, which will be organized on May 7.

L. B. Wickersham has been promoted to the office of chief electrical engineer for the Oregon Electric & United Railways at Portland, Oregon, having been succeeded as chief engineer of these roads by **A. M. Lupfer**, who recently succeeded **Ralph Budd** as chief engineer for the North Bank and affiliated railroads.

MEETING NOTICES.

Portland Electric Club.

The next meeting of the Electric Club of the Portland Railway, Light & Power Company will be held in the company's hall at First and Alder streets, Monday evening, April 29th. The speaker of the evening will be Mr. Harrison Allen, on "Commission Charts."

Electrical Development and Jovian League.

Last Tuesday was Pacific Gas and Electric day at the weekly luncheon. No business was transacted and the members present enjoyed a most instructive little talk by Mr. Fred Myrtle, advertising manager of the company, on the progress of the Spaulding Dam construction work. The address was supplemented by a fine collection of colored views.

Alameda County Electrical Development League.

The regular monthly meeting of the Alameda County Electrical Development League was held at the Hotel Oakland, Oakland, on Saturday, April 26th. J. A. Vandegrift presided, there being an attendance of about thirty members. The principal subject for discussion was "The Advantages of Membership in the National Electrical Contractors' Association." The next meeting will be held on May 21st, when the lamp question will be discussed.

Portland Electrical Contractors' Association.

The Portland Electrical Contractors' Association met Wednesday evening, April 23, at the Portland Commercial Club, at 6:30 dinner.

The nominating committee offered the following names for officers for the ensuing year: W. O. Fouch, president; Robt. Skeene, vice-president; F. C. Greene, secretary; J. R. Tomilson, treasurer; E. L. Knight, J. Drouillat, R. T. Littler, S. C. Jaeger, executive committee.

The new Universal Price Book for Oregon has now been gotten ready for the printer.

It was suggested that the semi-annual convention of the State Association be held in June during the Rose Carnival and a committee is now working on arrangements for same.

Oregon Technical Club.

Mr. J. E. Davidson, vice-president and general manager of the Pacific Power & Light Company, acted as chairman at the regular Tuesday luncheon at the Portland Commercial Club. He also was the speaker of the day, due to the fact that Mr. Guy W. Talbot, president of the Pacific Power & Light Co., was called out of the city and could not keep his appointment to speak to the club.

It was announced that the Architectural Club of Portland would hold an exhibition of all the plans and pictures of the buildings constructed along the coast during the last three years.

Mr. Davidson's talk was in opposition to the Celilo Power Development by the States of Oregon and Washington. The points he brought out were as follows:

1. No present market.
2. The tax on the people to pay for the development.
3. Low rates now existing in the cities in which power would have to be sold.
4. At present his company has a transmission system in the upper Columbia district costing $400,000 from which the gross revenue was only $20,000 per annum.
5. Competition of government irrigation projects in central Oregon.
6. The high elevation of the irrigation district between the Columbia River and the Yakima River prohibits electric pumping.
7. The moral obligation the people owe eastern bonding companies in not causing them losses on their investments which were placed here in good faith and from which they should realize from after going through the hard pioneering development work.

Mr. Corbin of the Engineering Club of Seattle, addressed the members and extended to them a standing invitation to attend the Seattle Club's luncheons which are held Thursday noon at the College Club, whenever any member of the club might happen to be in Seattle. The club adjourned and went in a body to visit the Portland Trades School.

The noon day meetings beginning with the month of May will be held on Monday (instead of Tuesday) at the Portland Commercial Club dining room "B." Time 12:15 sharp.

Monday, May 5th—Speaker, Prof. F. L. Griffin of Reed College. Chairman, Jas. R. Thompson of Oregon Society of Engineers.

Monday, May 12th—Speaker, Dr. Calvin S. White. Chairman, Robt. G. Dieck.

Monday, May 19th—Speaker, Jas B. Kerr. Chairman, H. W. Whitney.

Monday, May 26th—Speaker, Prof. E. H. McCallister of the University of Oregon. Chairman, H. S. Wells.

Los Angeles Section, A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers held its regular monthly meeting at Hotel Hollenbeck, on Tuesday evening, April 22, 1913. George A. Damon was in the chair, 74 being present. Mr. Lee Hagood of San Francisco, engineer for the Oro Electric Corporation, delivered an illustrated lecture on transmission lines and synchronous condensers. In his talk, Mr. Hagood applied convenient, original, graphic methods of working out data for the selection of condensers to be used as voltage regulators and for the control of power factor in such a way as to be of great interest to all. The paper was discussed by H. A. Barre with reference to use of synchronous condensers on the Big Creek project of the Pacific Light and Power Corporation, now under way. Others participating in the discussion were Budd Frankenfeld, George H. Stockbridge, Ralph Bennett and R. W. Sorensen.

Society for Electrical Development, Inc.

The contest announced by The Society for Electrical Development to secure a suitable trade-mark to be used by its members and by the society in its various campaigns to develop the uses of electricity, has been productive of almost an embarrassment of riches, and the accumulated ideas and suggestions that await the meeting of the Slogan Committee on May 5th should produce a design and slogan eminently suited for the society's purpose.

The great mass of ideas and suggestions made at the recent conference in New York for the active work of the society will give ample scope for the work of the Committee on Plans, which has been called to meet May 6th to evolve with the co-operation of the Executive Committee, the complete plans for carrying out the work of the society, which will be started when the minimum of $200,000 has been subscribed for this purpose.

The comprehensive plan will be presented to the membership at the annual meeting of the society, which in all probability will be held in Chicago the week prior to the annual convention of the National Electric Light Association. Plans will be presented to the industry at large in a publication which will be distributed shortly after the meeting.

The membership of the society is making a rapid increase and the expectation is that at the annual meeting in Chicago, an especially representative number of the men in the industry will be present.

The big broad scope on which the society's plans are to be organized should effect a great increase in the uses of electricity, in which practically every individual interest engaged in the industry will profit, so that a very complete cooperation of the various interests in the industry is expected, both in the development of the plans and in the subscriptions from members.

FINANCIAL NOTES.

The Pacific Light & Power Corporation of Los Angeles has authorized an issue of $5,000,000 one year, 6 per cent, secured gold notes, of which $2,500,000 is now being offered at par and accrued interest. They are due May 1, 1914, principal and interest being guaranteed by H. E. Huntington. This issue will be used to provide funds for the completion of the two new power plants now under construction at Big Creek, Cal., 240 miles of transmission lines to Los Angeles, etc. The additional funds are required because it was decided, owing to the growing demand for power, to construct plants of 67,000 horsepower initial capacity, an increase of 25 per cent over the originally contemplated 53,600 horsepower capacity, for which $10,000,000 first and refunding 5 per cent bonds have previously been sold. For the first two months of this year the gains over the corresponding months of last year are as follows:

	1913.	1912.	Pct.
Gross earnings	$434,204	$393,822	10.2
Operating expenses, taxes	248,990	236,336	5.3
Net earnings	$185,214	$157,486	17.6
Other income	19,482	3,893	400.4
Total income	$204,696	$161,379	26.8
Bond and other interest	78,603	87,894	†10.5
Balance	$126,093	$73,485	71.5

†Decrease.

The foregoing gross earnings for 1913 show an increase of 17.3 per cent over the corresponding period in 1911.

The item of bond interest does not include the charge on the $10,000,000 first and refunding 5s issued against the construction of the Big Creek plant. However, should the interest on the first and refunding 5s have been included, this statement would show a substantial margin over such requirements.

The California Railway & Power Company, which controls the United Railroads of San Francisco, has prepared its balance sheet as of March 31, 1913, as follows:

ASSETS.

Securities owned	$47,729,670
Notes receivable—United Railways of San Francisco	2,000,000
Cash and accounts receivable	190,779
Interest accrued	38,888
Deferred charges	9,323
Total	$49,968,662

LIABILITIES.

Prior preference stock	$3,000,000
Preferred stock	6,874,400
Common stock	40,000,000
Dividend on prior preferred stock, payable April 1, 1913	56,147
Profit and loss—surplus	38,114
Total	$49,968,662

TRADE NOTES.

The Safety Insulated Wire & Cable Company have closed a five-year contract with the Pacific Light & Power Corporation of Los Angeles for all underground cable to be installed.

Hunt, Mirk & Company, have closed a contract with the Mt. Whitney Power Company for a 5000 k.v.a. Westinghouse turbo-generator unit to be installed in the steam plant at Visalia.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

EXAMINATION FOR DEPUTY INSPECTOR OF ELECTRICITY.[1]

Electrical Wiring and Apparatus.

1. What kind of a current is required for series lighting system where no provision has been made for maintaining the circuit around the lamps?

2. How much more heat is produced by a current of 10 amperes than by a current of 5 amperes, both currents flowing through coils of the same length and size of copper wire?

3. What will be the drop of potential in a circuit of No. 14 copper wire 280 ft. long supplying nine lamps requiring 4.5 amperes? (Give work.)

4. (a) Name six alternating current systems of distribution. (b) Show by diagram a three-wire, 2-phase, and a four-wire, 2-phase, lighting system complete with necessary fuses and switches.

5. A single-phase circuit carries a load of 58 amperes, the power factor is 0.95, and the distance is 60 ft. What size of wire should be installed if a drop of potential of 3 volts is to be allowed?

6. Why is it desirable to have a starting box for a shunt wound motor that will never break the circuit?

7. (a) What is the object of an Automatic Starting Box? (b) How should the rheostats in series with the shunt coils of a dynamo be arranged?

8. (a) What is necessary to determine the proper size of wire for alternating current motors that are rated in horsepower? (b) What are the code requirements for the support of wires in conduit vertical risers?

9. A three-phase induction motor rated at 40 amperes per terminal on 220 volts is to be installed at a distance of 80 ft. from switchboard. The motor is slightly overloaded and the power factor is 0.85. A drop of 4 volts is allowed. What size of rubber covered wire will be necessary to comply with the code requirements?

10. (a) Why does the moving of the arm of a rheostat raise or lower the voltage of a compound wound or shunt wound dynamo? (b) Will reversing the shunt coil connection prevent a dynamo from generating? (c) For what two purposes is wire used on a dynamo or motor?

Electricity.

1. (a) In what two ways is electricity distributed for commercial use? (b) Name two principal ways that electricity is usually generated.

2. a) Into how many principal classes can electric circuits be divided? (State fully and show by diagram.) b) What is the difference between a metallic circuit and an earth circuit? (Show by diagram.)

3. (a) What is dynamic electricity? (b) Does electricity flow in a current like water, or a fluid? (c) What determines the power of an electric current? (d) Upon what does the power of an electric current depend?

4. (a) What does the term "Potential" mean as applied to electricity? (b) What does the term "Electromotive Force" signify?

5. (a) Does the flow of an electric current along a wire always produce heat? (b) Is the heat produced by the passage of an electric current always a loss of energy?

6. (a) What is an induction coil, and for what purposes is it used? (b) Show by diagram the circuit of a typical induction coil outfit.

7. What does an ampere-hour represent? (Give work.)

8. (a) What is an inductive circuit? (b) What is a magnetic circuit? (c) What is a Volt-Ampere?

9. Name three classes of dynamo-electric machines and for what use the machines are for.

10. What are the three essential parts of a constant potential transformer?

Practical Questions.

1. (a) Which is the more desirable for electric lighting and power work: constant pressure current, or constant current with varying pressure? (b) Can a three-wire system be used on any other system than a constant potential system?

2. (a) Upon what effect of the electric current does a circuit breaker depend for its action? (b) What usually occurs when a circuit carrying a heavy current is broken? (c) What is a reverse circuit breaker? (d) Where is such a breaker generally used?

3. What class of places is considered as being extra hazardous by the city electrical inspection department in which waterproof sockets must be installed? Name six such places, and the requirements of the inspection department for such installation.

4. (a) Name five code requirements for the installation of high voltage (550 v.) motors in buildings. (b) What are the code requirements for the tapping of wires at 3-way and gang switches? (c) Where two or more direct current motors are supplied from one service or from the same feeders, how would you determine the proper size of wire for service and feeders? (d) Where two or more alternating current motors are supplied from one service or from the same feeders, how would you determine the proper size of wire for service and feeders?

5. (a) What is the essential requirement of the Portland Railway Light & Power Company before connecting to main service? (b) Why is the lower limit of carrying capacity specified by the code for rubber-covered wires?

6. (a) Why does the speed of a motor increase as the field coils get warm? (b) What is the difference between the counter electromotive force produced in a motor, and the e.m.f. produced in a dynamo? (c) Why is it that the Edison three-wire system is economical of copper?

7. How many amperes equal one horsepower on a 110-volt circuit? On a 220-volt circuit? On a 500-volt circuit? On a 1000-volt circuit? On a 10,000-volt circuit?

8. If you were an electrical inspector, sent to inspect an installation of electric wiring in a building and found that there were some minor things that did not strictly conform to the code requirements, but which were mechanically all right and did not add to the fire and life hazard risk by not so complying with the code, would you pass the installation as being O. K.? (State fully.)

9. Show by diagram a method of connecting lamps in a circuit so as to get even voltage at lamps even with great drop in the line.

10. (a) What is a horizontally wound armature? (b) What is a vertically wound armature?

[1]Given by Civil Service Commission of Portland, Oregon, April 17, 1913.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Railroad Commission has issued an order effective June 1 requiring all public utility companies under its jurisdiction, including common carriers, to furnish the following information:

1. An itemized statement of new issues of stock during the years 1911 and 1912.
2. The net cash realized from each certificate so issued.
3. The purpose to which the money so raised was devoted.
4. An itemized statement of bonds issued during the same years.
5. The cash realized from the sale of such bonds.
6. The purpose to which the money so raised was devoted.
7. Notes issued between January 1 ,1912, and June 1, 1913.
8. The cash or other considerations realized from such issues of notes.
9. The purpose to which the funds raised by issuance of such notes was devoted.

The Union Home Telephone & Telegraph Company, operating in southern California, has made application for authority to issue bonds in the sum of $161,000 to meet maturing obligations.

The railroad commission has rendered a supplemental opinion following its original order by which it established the basis upon which utilities might deviate from the published schedule of rates. All utilities shall file a list of their deviations, with the reason for such deviations, and shall indicate which deviations they desire to retain and which to eliminate. The commission will then determine each particular case. The rates which were in effect before the commission assumed jurisdiction shall remain in effect until the commission authorizes a change. The commission sets forth that in removing discriminations the question is always open whether such discrimination shall be moved by raising one rate or by lowering another. To that end the commission proposes that each specific case be treated upon its merits and that no changes which could have the effect of increasing rates be made arbitrarily by the utilities.

Frank F. Cady and Rilla E. Cady asked permission to issue notes secured by mortgage on a water system for $10,000, the Honey Lake Valley Mutual Telephone Association to issue promissory notes for $10,000 and the Beaumont Gas & Power Company to issue notes and other evidences of indebtedness for $5000.

Authority has been granted to the Sacramento Natural Gas Company to issue bonds to the amount of $193,000. The bonds are to be used to pay existing obligations and for the following new construction: Gas holder, $35,000; site for gas holder, $6000; meters, $5400; extensions of mains and service pipes, $95,000; new gas well, $15,000.

A certificate of public convenience and necessity has been granted to the Midway Gas Company to conduct natural gas from the fields in Kern county and to distribute it in Los Angeles and vicinity. A previous application by the Midway Gas Company was denied on the ground, first, that the company was organized so as to create a monopoly whose rates could not be regulated, and, second, that it proposed to take gas from the territory in dispute between the Southern Pacific Company and the United States government without providing any protection for the rights of the government.

The Southern California Edison Company has applied to the Railroad Commission for authority to sell 30,000 shares of its common capital stock at a total par value of $3,000,000. The company desires to use the money to redeem outstanding debentures, $332,000, to discharge floating debt, $1,105,000, and the balance to be used for additions and betterments of the plant.

The Southern Sierra Power Company has applied to the Railroad Commission for a certificate of public convenience and necessity to operate under franchise in Kern County.

D. C. Gillen and the Pacific Gas and Electric Company have joined in the application to the Railroad Commission asking that the former be given authority to sell to the latter his electric system in the city of Colusa and vicinity for $12,000.

The Railroad Commission rendered a decision denying the application of the New Freeport Telephone and Telegraph Company for permission to raise its local rates. The company operates in a territory near Sacramento. Investigation by the Commission enabled the applicant to obtain modified switching arrangements with the Pacific Telephone and Telegraph Company, which will serve to increase materially its revenue. With this adjustment the increase in rates was found unnecessary.

Adhering to a previously announced policy that where a utility is serving a given field adequately a second utility would not be authorized to enter the field, the Commission on the 29th granted authority to the Oro Electric Corporation to serve a portion of San Joaquin County, but withholds from the corporation for the present authority to enter and compete in the city of Stockton.

Under the terms of the decision, the Western States Gas and Electric Company, which now serves Stockton, is given ninety days within which to complete the reconstruction and unification of its system, to improve its service and to meet the rates proposed by the Oro Corporation. If at the end of that period the Western States shall have satisfied the Commission as to the adequacy of service and the reasonableness of its rates, the Oro Electric will be denied the right to enter Stockton, but if the Western States fails to convince the Commission of these essentials, the application of the Oro Corporation will be granted.

The Commission found that the Western States' service was not what it should be, but ascribed this, in part, to the fact that the company is reconstructing and unifying its system, and for that reason preferred to give it sufficient time to show what it could do. The Commission also, in reaching its conclusion, took into account the rates and service of the Oro Electric in territory it now serves, and declares that its rates are abnormally high, and that, although a promise to lower the rates had been given, the promise had not been fulfilled.

"We cannot," said the Commission, in the decision, "escape taking into account the past performanaces of the Oro Electric as an indication of how well it is liable to meet its promises in the future."

The specific territory the Oro Electric is permitted to serve is in San Joaquin County, from a point south of the right of way of the Santa Fe Railroad east of Bixler, through Stockton and Burnham to the easterly boundary of the county, except the city of Stockton, and also all portions of San Joaquin north of the right of way of the Santa Fe except incorporated cities and towns and a strip of territory a mile wide to the north and east of Stockton and the island territory in the western portion of the county.

The Commission points out that, while the effect of its previous decision regarding utilities seeking to enter fields already adequately served has been to bring about some improvement, the utilities are not yet living up to their duty to the public in non-competitive territory. It declares that in judging a utility under this rule, it will consider the utility's attitude in all of the territory it serves.

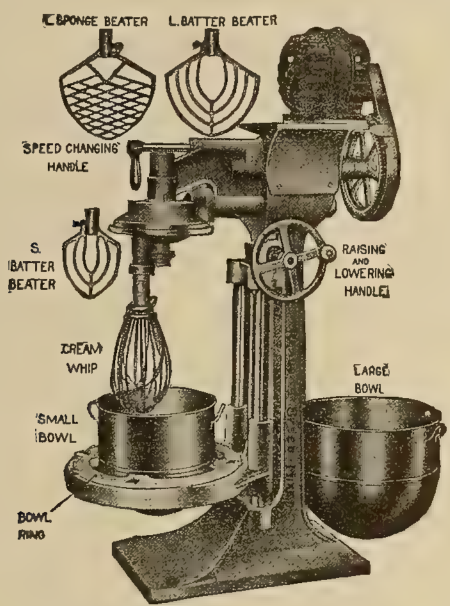
It further declares that the Oro Electric can furnish rates that it proposes in Stockton, but has apparently just shaded under the Western States' rates for the purpose of making a showing at the hearing, and criticises this practice, calling attention of utilities desiring to enter competitive territory to the fact that they will be judged by their willingness to do their best, and not merely to shade the rates of the existing utility.

INDUSTRIAL

MOTOR DRIVEN MIXER AND BEATER.

The use of machines driven by small individual electric motors has proved a great source of economy in bakeries, confectionery plants, hotels, and restaurants. These machines do their work much more rapidly than it can be done by hand, and produce better and more uniform results at an insignificant expense for current. Hence the cost of labor is greatly reduced; the work can be put through with less delays, and working conditions in the kitchen or bakery are greatly improved by reducing the number of people employed in it and lessening the amount of material standing around and spilled.

Motor driven machines of all kinds can be obtained; egg and cake beaters, dough mixers, dish washers, knife grinders, silverware polishers, vegetable parers, fruit pitters, etc. The beater and mixer illustrated herewith is a



Motor-Driven Mixer and Beater.

typical example of these time and labor saving devices, and gives an excellent idea of what can be accomplished by them.

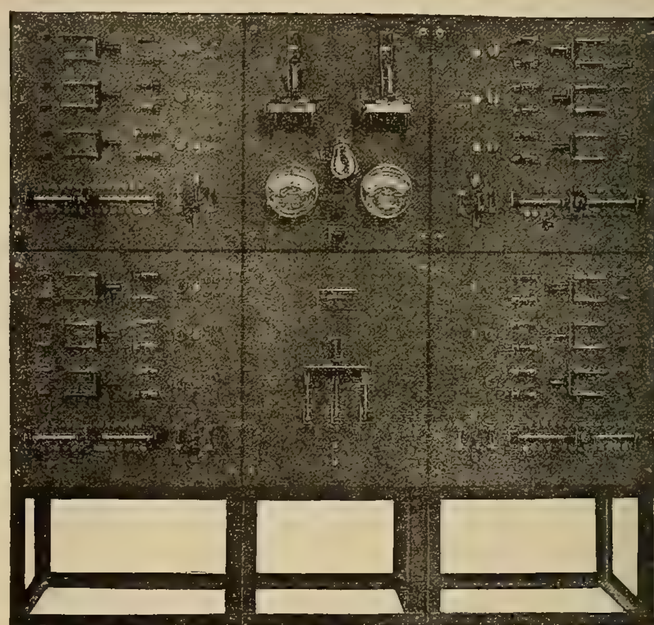
This machine is applicable to all classes of plain and fancy cake, biscuit, and egg work, fruit and other pie fillers, jams, jellies, sauces, dressings and other preparations that require mixing and mashing.

The beating bowl rests on a stand which can be raised to the beater by turning a handle. When the operation is completed, the bowl is lowered and another substituted. A variety of styles and sizes of paddles, such as beaters for sponge, batter, eggs, cream, fruit, pumpkin, cheese cakes, and potatoes can be supplied for the machine and since one can be quickly replaced by another, the operation of the machine can be made practically continuous regardless of the kind of work to be done.

The machine has three speeds, any one of which can be obtained by turning a handle without stopping the machine. The capacities of the bowls which are supplied with the machine are 30 and 80 quarts. Where the mixture to be beaten must be kept hot or ice cold, a water bath is supplied. The machines are made by the Read Machinery Company, York, Pa. Westinghouse motors are used to drive them.

CUTLER-HAMMER PANELS FOR CHARGING BAGGAGE TRUCKS.

The use of motor-driven trucks in factories, railroad stations and other places where baggage is handled has been found to be of considerable advantage. For the charging of the batteries of these trucks, the Cutler-Hammer Manufacturing Company Milwaukee has installed a number of charging equipments, one of which is shown in the accompanying illustration. This is installed in the North Station, Boston, of the American Express Company, and is designed to charge from one to twelve of the 12-cell trucks at one time. There are four charging rheostat panels, two each side of the center panel, and each of these is arranged for charging one truck alone, or two or three in series. The rheostats are of the slider type with resistance grids mounted in frames back of the panels. The double throw



Cutler-Hammer Battery-Charging Equipment for Charging Electric Baggage Trucks.

switches, above the rheostat contacts when thrown to the right connect the batteries of the two or three trucks in series, and when thrown to the left cut into the circuit a fixed block of resistance sufficient to absorb the voltage of the battery at maximum current.

The arrangement for charging in groups allows the most economical use of current while at the same time keeping the number of separate rheostats to a minimum and the price consistently low. One truck can be charged alone if necessary, but it is usually possible to put two or three on charge at the same time.

The center panel carries single pole circuit breakers for each of the outside wires of the 3-wire system, on which this equipment is installed, and the meters. In this particular case plug receptacles were placed on the panels with tell-tale lamps opposite each receptacle which indicate when a battery is plugged in for charging.

The Puget Sound Traction, Light & Power Company has purchased three electric trucks and one electric railway tower wagon. The company is going to push the electric vehicle business.

NEWS NOTES

INCORPORATIONS.

MASON, NEV.—Articles of incorporation of the Mason Valley Telegraph & Telephone Company have been filed preparatory to invading this field with a modern telephone system.

LAS VEGAS, N. M.—The Clear Creek Power Company has been organized at Wyoming to do business in New Mexico. The company will furnish water power, and is capitalized at $1,500,000. James C. Fitch is agent in the state of New Mexico, and will be located at Socorro.

ILLUMINATION.

RIDDLE, ORE.—J. B. Caples, Canyonville, will endeavor to secure a franchise for electric light and power here.

ARLINGTON, ORE.—The citizens of this city have voted bonds in the sum of $5000 for the purpose of installing an electric light plant.

CLOVERDALE, CAL.—The California Telephone & Light Company has applied for permission to purchase the electric light and power distribution system of the Cloverdale Light & Power Company, operating in Cloverdale and vicinity.

SACRAMENTO, CAL.—By the terms of a new ordinance effective July 1 of this year gas will be furnished to consumers of this city for 95c per 1000 cubic feet, a reduction of 5c on the rate charged for the past several years by the Pacific Gas & Electric Company and the Sacramento Natural Gas Company.

RAISIN CITY, CAL.—The San Joaquin Light & Power Company has a large force of men here setting poles for the electric wires from the substation at Caruthers. This will bring the electric lighting system to the homes of Raisin, and a number of farmers are also considering the installation of electric pumping plants.

PORTLAND, ORE.—The Pacific Fire Extinguisher Company have obtained the contract for ornamental lamp posts on the Union bridge. The city is calling for bids to install ornamental post lighting systems in the various parks. Councilman Menefee has succeeded in getting measures through the Council by which all the bridges across Sullivan's Gulch will be well lighted with cluster lights, including Union, Grand, East, Twelfth, East Twenty-first and East Twenty-eighth street bridges. The appropriations for the lighting of these bridges have been made.

TRANSMISSION.

ALMIRA, ORE.—The city has granted the Washington Water Power Company permission to string wire and poles for power and light and heat.

MARTINEZ, CAL.—The Great Western Power Company has applied for a blanket franchise covering the surveys of all the roads in Contra Costa county.

ALMIRA, WASH.—The council has granted a franchise to the Washington Water Power Company to string poles and wires for distribution of electricity in this city.

MONTREAL, CAN.—The directors of the Cedar Rapids Power Company let out work in connection with the new hydroelectric development amounting to $3,000,000, to Fraser, Brace & Co., of New York.

LOS ANGELES, CAL.—The Board of Public Utilities has accepted the bid of the Cresmer Manufacturing Company for the erection of a new transmission station in Arlington district, designed to receive current contracted for with the Southern Sierra Power Company.

CHEHALIS, WASH.—Manager H. C. Coffman of the Washington-Oregon Corporation, states that the company has appropriated $15,000 to be used in improving and enlarging the water plant. The reservoir will be rebuilt and enlarged, new main line pipes will be laid and gates installed.

EL PASO, TEXAS.—The West Texas Electric Company of Big Springs, Texas, has started work of making improvements on the plant. The building will be enlarged and additional machinery added. New poles are replacing old ones, and the system generally placed in good condition. Cost will be about $20,000.

ASTORIA, ORE.—The Pacific Power & Light Company has filed a petition with the county court asking for a franchise for extending its transmission lines to the west part of the county. From Astoria the line will be constructed to Warrenton, Hammond and Fort Stevens, from where it will be extended to Gearheart park.

GARDNERVILLE, NEV.—Great strides will be made in pump irrigation in this valley. The Truckee River Electric Company is building its power line up the river with its terminal point at Genoa where the company will furnish lights. The farmers below Genoa are arranging to install electric pumps to irrigate land that has never been cultivated.

VANCOUVER, WASH.—The big concrete power station, built by the Mount Hood Light & Power Company at a cost of $11,000 and sold to the Portland Railway Light & Power Company, is being moved to First and Washington streets. Several weeks will be required to move the 8000-ton building through the garrison, as much as 60 ft. having been made in one day.

SAN FRANCISCO, CAL.—The Great Western Power Company has applied to the railroad commission for a modification of its recent order authorizing an issue of $4,411,000 in bonds. The company asks that money heretofore authorized for new lines, substations and transformer sets to the amount of $92,562, be made available under a modified order for extensions in the Napa district, the Oakland district, the Petaluma district, the Island district and for minor purposes of general improvements.

OROVILLE, CAL.—With the completion of the Oro Electric Company's power line from Biggs to Oroville on April 24th connection was made with the Northern California Power Company, which has a contract with the Oro company to supply it 30,000 volts in Butte City for this line. The Northern California Power Company has two other contracts with the Oro company, both of which soon will become operative. One contract is for the delivery of 60,000 volts five miles north of Colusa to be used on the Stockton and Natomas line and the other is for the same voltage to be delivered near Chico for the Oro's Belden line. The latter line should be completed in three weeks, while the former will probably be ready for connection in three or four months.

TRANSPORTATION.

SAN FRANCISCO, CAL.—Four of the 65 cars ordered by the United Railroads have arrived from St. Louis. They were taken to the Geneva-avenue shops for equipment of electrical apparatus. Six more cars are expected within the week.

SAN FRANCISCO, CAL.—The board of public works awarded the contract for the railway track construction on Geary street, Thirty-third avenue, Balboa, Forty-fifth avenue, Cabrillo street, from Geary street, near Thirty-third avenue to

the great highway to the Healy-Tibbitts Construction Company, for $34,450.

LEWISTON, IDAHO.—The contract has been let by the Lewiston-Clarkston Valley Railway Company for the purchase of its substation equipment and electrical appliances for the first unit of the road. W. C. Campbell, advisory engineer in the railway department of the General Electric Company, secured the contract for the machinery.

COLUSA, CAL.—The trolley lines of the Northern Electric are ready for the entry of the first train into Colusa. The bridge at Meridian is practically completed and the laying of tracks between Meridian and Colusa will take less than a week for completion and in all probability the first train will enter Colusa in ten days.

EUREKA, CAL.—An electric railroad from Korbel to the Eel River valley section is the proposition being investigated by Richard H. Tingley, electrical engineer of a French syndicate, who is here in response to the invitation of the Humboldt promotion and development committee. Tingley represents capitalists who are developing the electric railroad business in several parts of the United States.

STOCKTON, CAL.—The Tidewater & Southern Railway has commenced the work of electrifying its line from this city to Modesto. Two carloads of poles have been received, and distributed for a considerable distance south of Stockton. Chief Engineer J. H. Wallace has assembled a construction crew of 40 men for the work of erecting the poles and stringing wires. A large portion of the material needed has already been delivered. Wallace believes that the overhead system will be completed in about 60 days.

MODESTO, CAL.—Announcement has been made that the Modesto Interurban Railway, now in operation between Modesto and Empire, on the Santa Fe, will be extended at once to Waterford, 13 miles east of Modesto. All of the rights of way have been secured and construction work will start at once. Surveys have also been made for the extension of the road to La Grange, on the Tuolumne River, 33 miles east of Modesto, as soon as the Waterford extension is completed.

SAN FRANCISCO, CAL.—The operation of Geary street cars to the ferry will be instituted about June 1, according to present plans of the municipal government, the United Railroads and F. Rolandi, the contractor who will extend the municipal line from its present terminus at Kearny and Geary streets to the United Railroads' tracks on Market street. It has developed that actual work on the extension legally cannot be instituted until an official canvass of the votes has been taken and the results made known. As soon as the official count is taken the city and the street railway corporation will file a stipulation with the Supreme Court asking for a dismissal of the present appeal concerning the trackage agreement now before the court.

TELEPHONE AND TELEGRAPH.

PENDLETON, ORE.—The council has granted a franchise to the Independent Telephone Company, Pilot Rock, to maintain poles and wires on all streets, except Main and Court.

SUMAS, WASH.—The contract for the telephone block on Garfield street, has been let to Mr. F. M. Smith, Lynden, and work has been started.

FALLON, NEV.—The city council has granted a franchise to construct, operate and maintain a telephone and telegraph system in the city of Fallon, to a municipal corporation of the state.

LOS ANGELES, CAL.—The Union Home Telephone & Telegraph Company, operating in Southern California, has applied to the commission or authority to issue $161,000 of bonds for the purpose of paying existing obligations.

CLOUDCROFT, N. M.—C. A. Redic, president of the James Canon Telephone Company, attended a meeting of stockholders held recently. It was voted at the meeting to purchase the necessary material and go ahead with the construction of the line, several of the stockholders already having poles along the road where the line will run. Practically all the farmers along the line for a distance of 20 miles are stockholders.

WATERWORKS.

WOODLAND, CAL.—It has been decided by the Board of Trustees that Woodland have a bond election soon to provide funds for enlarging and extending the water system, sewer system, and fire fighting facilities.

BELLINGHAM, WASH.—Definite plans for the route of the new intake for the city water system to be constructed at Lake Whatcom this summer, have been adopted by the city water board. Work is to begin as soon as possible.

VALLEJO, CAL.—The city of Vallejo is to purchase 500,000 gallons of water per day from Fred Jones, the Green Valley orchardist, delivery to be started as soon as he can lay the necessary pipe from the wells on his ranch to the municipal pumping station.

PETALUMA, CAL.—An ordinance was introduced providing for the voting of bonds to the amount of $375,000 for the purchase of the physical property of the Petaluma Power & Water Company. The special election will be called on June 10th.

CENTRALIA, WASH.—The Washington Oregon Corporation has appropriated $15,000 for the improvement in the water system at Chehalis, the money to be expended immediately. Water will be extended to those parts of the city not already covered by the service.

SAN BERNARDINO, CAL.—The Empire Water Company, in which a number of San Bernardino men are interested, is preparing to install an immense hydroelectric plant in Coyote Creek, in the San Bernardino mountains, and has made application to the state railroad commission for authority to issue bonds in the sum of $200,000.

WATTS, CAL.—Plans have been complete by Frank E. Lathrop, consulting engineer of Los Angeles, for the municipal water system for this city. At the last meeting of the council, arrangements were made for calling a bond election to vote bonds in the sum of $100,000, with which to provide for the installation of the water system, chemical engine for fire-fighting purposes, and electric fire-alarm system, covering the entire town.

SAN JACINTO, CAL.—Angelo Domanigoni has filed on 3000 inches of water in Tauquit creek, for irrigation. He will convey same to a power house 10 miles below the point of appropriation above the junction of south fork of San Jacinto River with the main stream of the San Jacinto River, and above the diversion dam of the Lake Hemet Water Company. Water and electric energy is to be carried to lands adjacent to the San Jacinto River below the city of San Jacinto.

RIVERSIDE, CAL.—A special election will be held May 19th, for the purpose of submitting to qualified voters the question of incurring a bonded indebtedness for acquisition and construction of domestic and irrigating water works, system, the same to comprise the systems of the Riverside Water Company, Riverside Artesia Water Company, and H. P. Kyes, and the same to be combined, extended and bettered according ta the report of Messrs. Burns & McDonnell, consulting engineers. The estimated cost of the improvement is $1,160,000.

PROFESSIONAL DIRECTORY

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

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Manhattan Elec. Supply Co.
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Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
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Batteries, Wet
Pacific States Electric Co.
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General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
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Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

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D. & W. Fuse Company
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General Electric Company
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General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
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Kellogg Swbd. & Supply Co.
Western Electric Company

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Fort Wayne Electric Works
General Electric Company
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"Century," R. J. Davis
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Pacific States Electric Co.
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Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

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Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
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"Century," Single Phase. R. J. Davis, R. R. Poppleton, W. M. Price Co., A. T. Egan.
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General Electric Co.
Wagner Electric Mfg. Co.
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Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
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Sprague Electric Works
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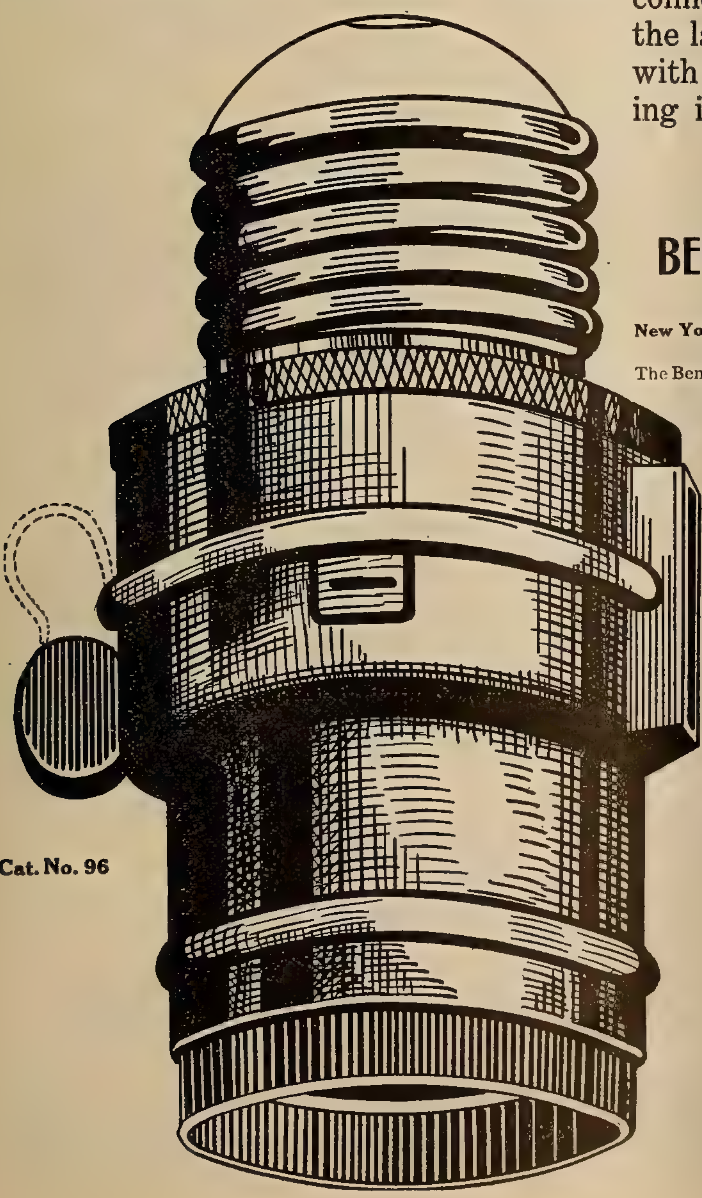

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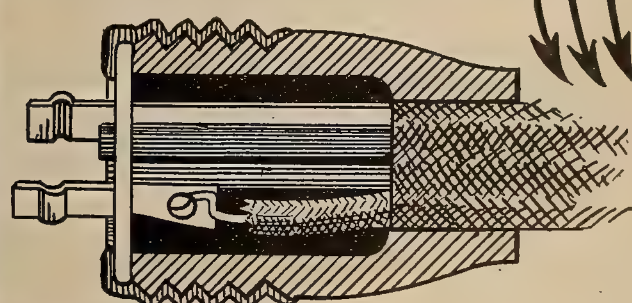

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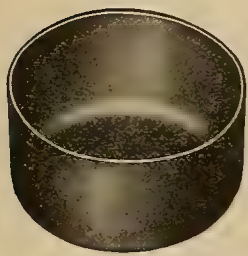

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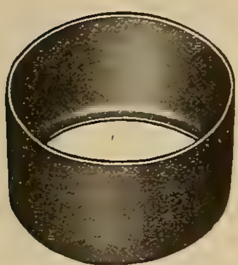

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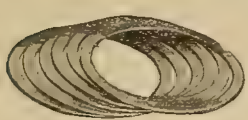

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Assembled Field Punchings for A. C. Motors.

The illustrations show the principal steps in the construction of the "Drawn Shell" motor manufactured by the General Electric Company.

To all who possess a quick discernment for real values in goods electrical, "Drawn Shell" construction has many interesting features which become readily apparent from a close inspection of the product.

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The satisfactory continuous operation at brake horsepower rating of all Drawn Shell Motors, with ample margin for reasonable overloads without sparking or overheating, is made certain by a careful, initial design and those niceties in mechanical and electrical construction, characteristic of all material bearing the trade mark "G-E".

Drawn Shell Motors are used to drive small machine tools, pumps, compressors, vacuum cleaners, sewing and washing machines, etc., etc.—these sturdy little motors meet an infinity of power purposes for shop, factory, store, office or home.

Sizes 1/50 to 3/4 H.P.—with open or totally enclosed frames.

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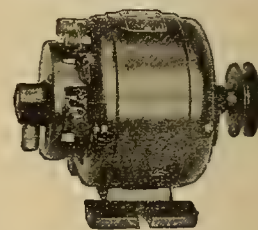
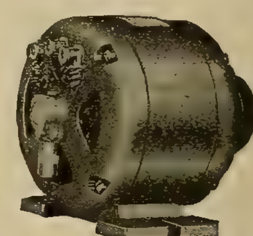


Type DSD Direct Current Motor

Type DSS Single-Phase Alternating-Current Motor.



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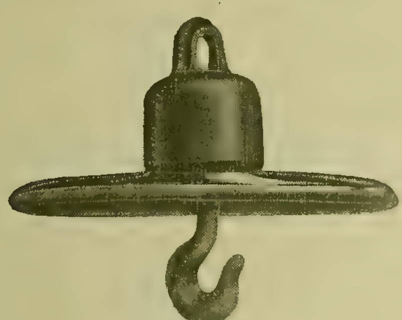

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Volts Dry Test	Volts Rain Test	Leakage Distance	Arcing Distance
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These Units are recommended for Voltages as follows·

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages 9, 10.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX SAN FRANCISCO, MAY 10, 1913 NUMBER 19

FAULTS IN UNDERGROUND CABLES

BY C. A. GAINES.[1]

In San Francisco most of the electric current supplied to the consumers of the Pacific Gas & Electric Company is transmitted from the generating station located at Humboldt and Georgia streets, to the six substations of the company through sixteen different feeders, which are for the most part underground. About 185,000 ft. of 11,000 volt lead covered cable is used for this purpose, and about 45,000 ft. is used for connecting between the different substations, thus making a total of 230,000 ft. or 43½ miles of 11,000 volt cable.

Burned-Out Splice.

Test Outfit for Finding Faults.

In addition to this there is many times this amount of lower voltage underground cable used for distributing current from the substations, but as these cables have numerous junction boxes where the cable can be easily sectionalized and tested, the finding of a fault becomes a simple matter and only in exceptional cases is it necessary to resort to special methods of testing to determine the fault location.

The following tests are therefore more often used on the power house cables, which are continuous from station to station, and on which the opening of a splice to test is an expensive as well as a slow process.

These power house cables, as they are called, consist of three copper conductors carefully insulated from one another and from the ground and the whole then incased in a sheath of lead ⅛ in. thick, which makes the cable impervious to moisture. Cable failures are often due to an injury of the lead covering, allowing moisture to enter the insulation and thereby reducing its insulating qualities and permitting the current to go to the ground, producing a fault known as a "ground," or to go from conductor to conductor, which is known as a "short."

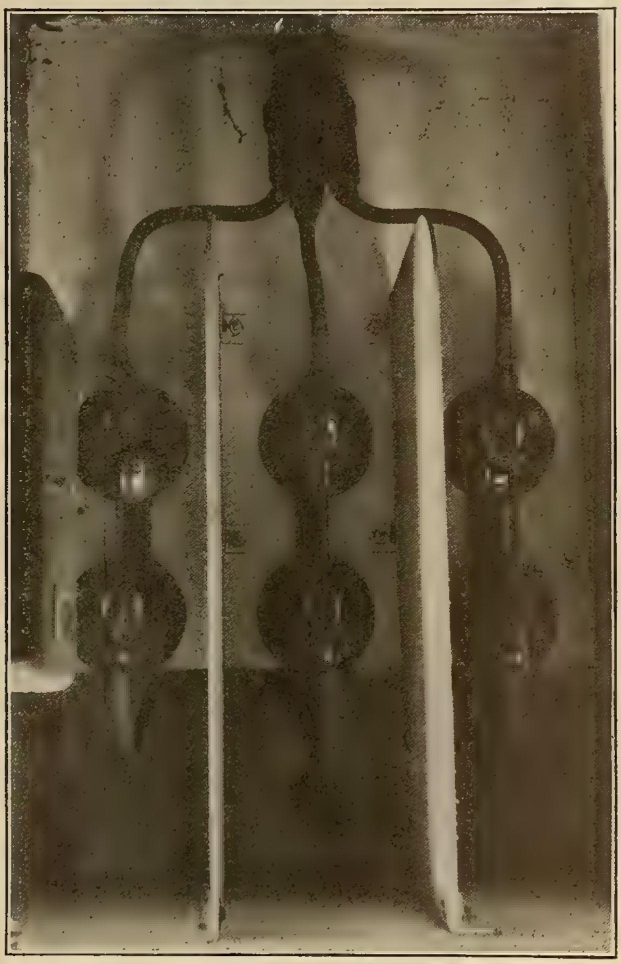
The resulting fault, which one may be called upon to locate, may consist of a short between two or three of the conductors, or a ground upon one or more, or a combination of shorts and grounds, or sometimes all the conductors may be burned clear from one another and from the ground. In the latter case a test from one station will probably reveal a different condition than a test from the other end of the cable.

As the lead covered cables are installed in underground ducts with but a few feet exposed in manholes, which are located 200 to 500 ft. apart, it can readily be seen that the location of a fault is not simply a question of inspection. Not more than 3 per cent of

[1]Cable testing expert for the Pacific Gas & Electric Company.

the total length of a cable can be seen after it has been installed, yet it is advisable, where time is an important factor, to immediately start an inspection of manholes, for, on a cable a mile long, an inspection of the cable in the manholes, started from both ends, can be completed before a location can be made by testing from one end. Often, too, an odor of burnt insulation will reveal the location of the fault when it is several feet from the manhole in the duct. While this inspection is progressing tests should be made at the station to determine the character of the fault and then preparations should be made for one of the following tests.

The most easily understood method of determining the location of a fault by test is to send an interrupted current over one conductor through the fault,

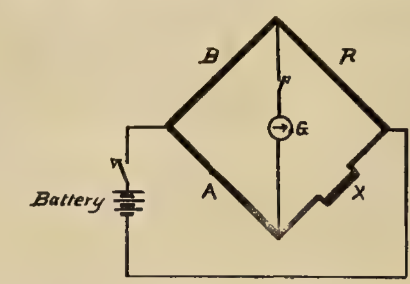


High-Tension Cable Junction.

returning in the case of a short through another conductor, and in the case of a ground through the earth. An exploring coil, consisting of an iron core wound with a large number of turns of fine wire, with a telephone receiver attached, is then held near the defective cable and the presence or absence of the pulsating current can be determined by the sound in the receiver.

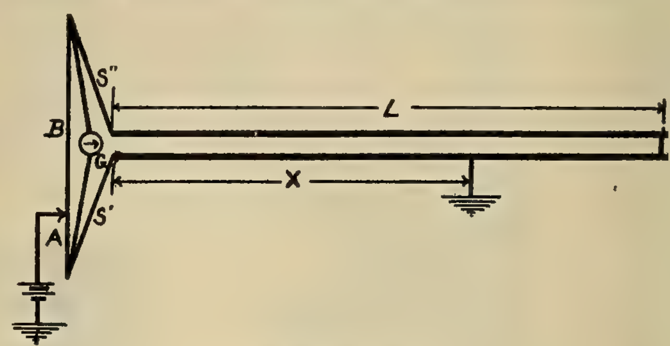
When testing for a short the spiral arrangement of the conductors is taken advantage of and the coil is held with axis parallel to axis of cable, but when locating a ground the coil is held across the cable. The coil should be moved around the cable in order to get the maximum effect from the testing current, as well as to reduce the effect of other current carrying conductors in the neighborhood.

In locating a ground the return current may follow the lead covering of the cable for some distance, neutralizing the effect of the current within the cable,



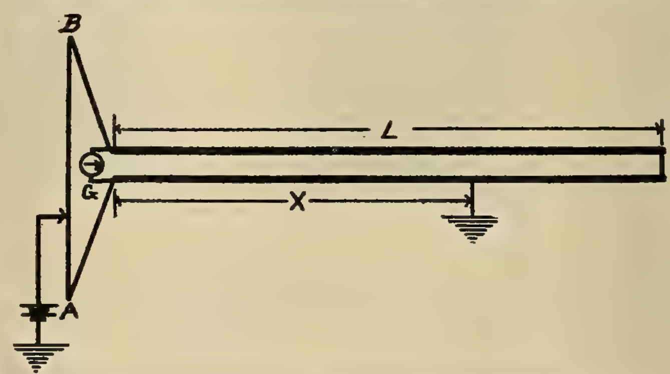
The Wheatstone Bridge.

and, instead of obtaining a definite location the operator finds a zone where the sound given by the exploring coil is very faint. The sound may cease entirely before the fault is reached, or it may continue some distance beyond the fault, making this method of locating a ground at best, but an approximate one.



The Murray Loop.

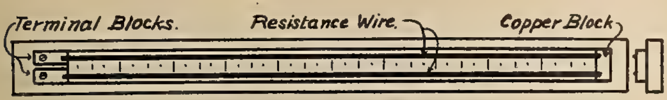
There are two methods using the principle of the Wheatstone Bridge which depend upon the resistance of the conductor from station to fault. In finding the ratio between this resistance and the resistance of the entire length of one conductor we have the ratio between the distance to the fault and the length of the cable. For instance, if the resistance of the conductor as far as the fault is one ohm, and the resistance of the conductor from station to station is three ohms, then the fault is 1/3 of the distance from the testing station.



Murray Loop With the Leads as a Part of Bridge Wire.

The Murray loop test is the most readily understood of the two, and also has the advantage that it can be used with a slide wire bridge with almost no

calculating. In this test a loop is made with one good conductor and one faulty conductor by connecting them together at the opposite end of the cable from which the test is made. In the case of a grounded conductor the battery is connected between the slide and the ground, the return for the battery being through the fault. A sensitive voltmeter, or galvanometer, is connected to both ends of the slide wire where they join the cable loop. When the fault consists of a short, one faulty wire is used in place of the earth.



Double Slide Wire Bridge.

In either case it is necessary to have one good conductor, although this does not have to be one of the three in the faulty cable. However, if the good conductor is not of the same length, or of the same size, as the faulty one this method of testing becomes more complicated and the Varley loop test, mentioned later, will give more satisfactory results. The Varley loop test also gives more accurate results where the resistance of connecting wires is an appreciable per cent of the resistance of cable under test.

For locating a ground the connections of the Murray loop test are shown in Fig. 1. The slide is moved until there is no deflection of the needle of the instrument "G," then

$$X = \frac{2\,A\,L}{A + B}$$

with the bridge in use in San Francisco A + B = 200 cms., which reduces this equation to

$$X = A\% \text{ of } L.$$

Suppose A = 33 Cms. on this bridge, then X = 33% of the total length of the cable.

(To be continued.)

DIAGRAMS FOR LINE CALCULATION.

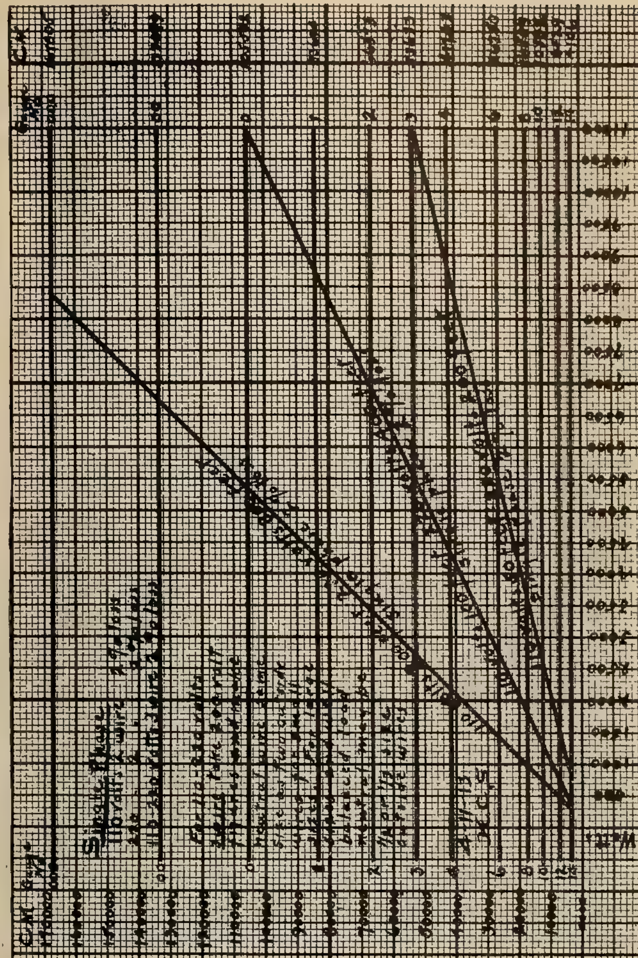
BY H. C. STODDARD.

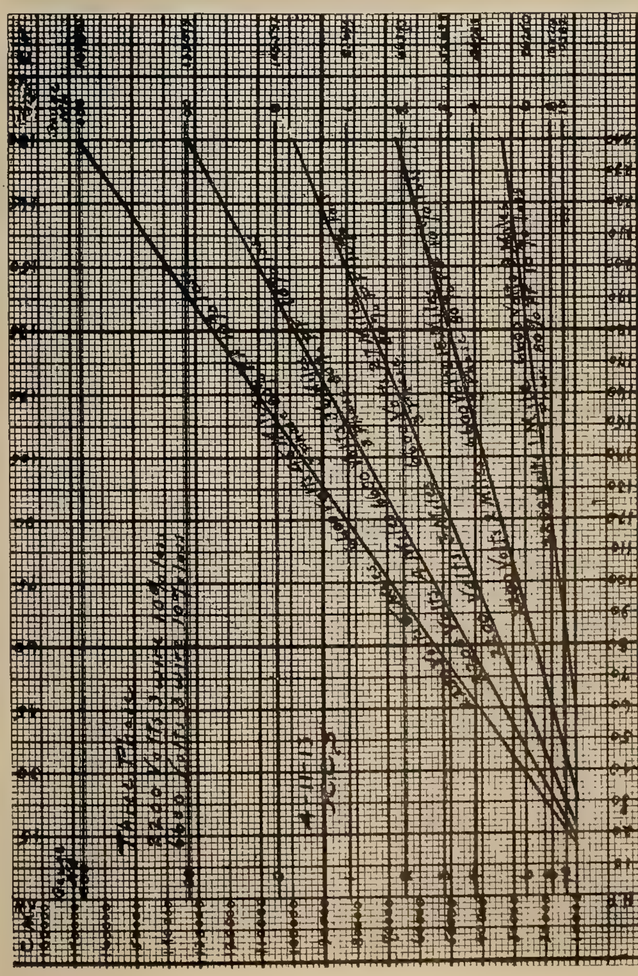
The accompanying charts were recently submitted at a meeting of the California-Oregon Power Company's Club with the idea of furnishing the field men with the method of preliminary calculation of transmission lines. They are based on the general wiring formula:

$$\text{Size wire in circular mils} = \frac{\text{Distance} \times \text{Watts} \times K}{\text{Per cent loss} \times \text{Voltage.}}$$

$$\text{Per cent loss} = \frac{\text{Distance} \times \text{Watts} \times K}{\text{Circular Mils} \times \text{Voltage}^2}$$

Distance = Distance in feet one way.
Watts = Total watts to be delivered
For direct current K = 2160.
For single-phase lights only K = 2400.
For single-phase lights and motors K = 3000.
For single-phase motors only K = 3380.
For three-phase motors only K = 1690.
For three-phase motors and lights K = 1500.
For three-phase lights only K = 1200.
For iron wire multiply K × 6.
For three-phase iron wire use K = 10,000.

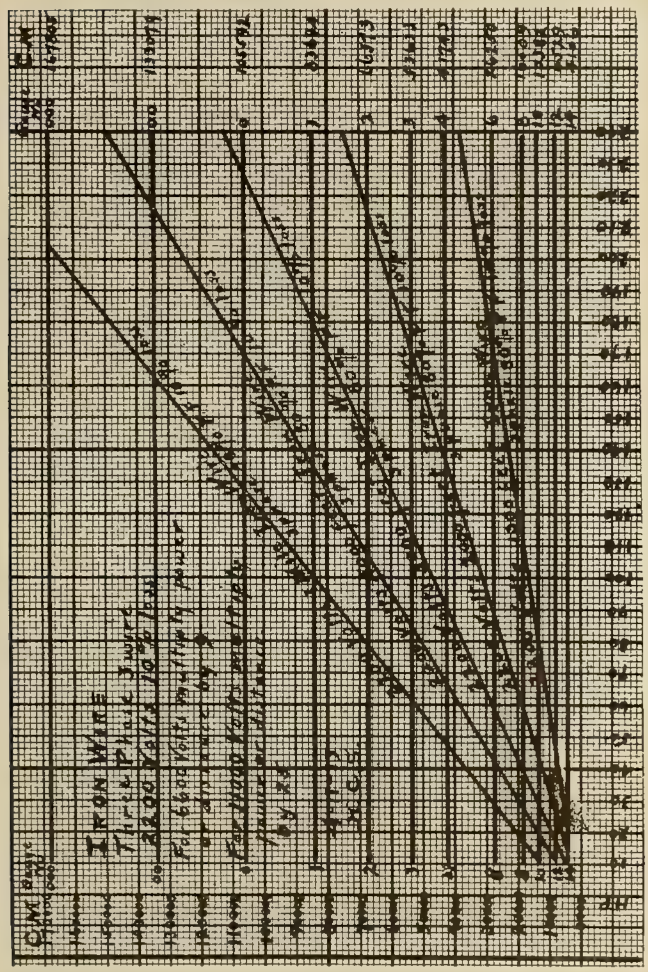


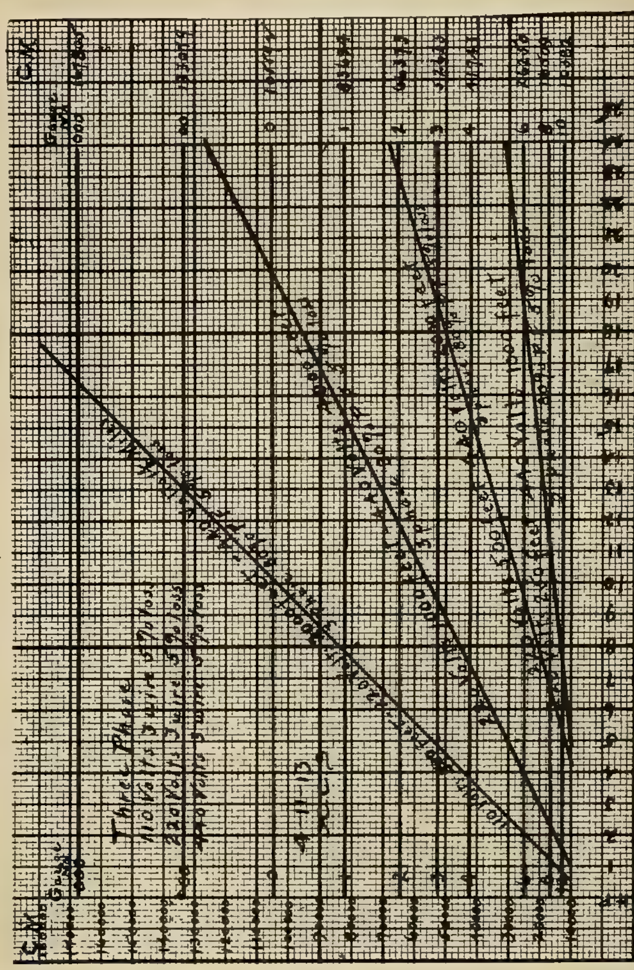


WEIGHT OF WIRE.

Gauge No.	Amperes Carrying Capacity Weatherproof.	Iron. 1000 ft.	Iron. Mile.	Bare Copper. 1000 ft.	Bare Copper. Mile.	Insulated Copper. 1000 ft.	Insulated Copper. Mile.	Steel Core Aluminum. 1000 ft.	Steel Core Aluminum. Mile.	Stranded Aluminum. 1000 ft.	Stranded Aluminum. Mile.	Aluminum Equivalent in Carrying Capacity to Copper Gauge No.
14	16	19	100	13	68							
12	23	32	170	20	106							
10	32	50	260	32	166	53	280			9½	50	12
8	46	72	380	50	264	75	395			15	80	10
6	65	102	540	80	420	112	590			24	126	8
4	92	138	730	128	674	164	865	57	302	39	204	6
2	131			202	1071	260	1370	91	492	61	324	4
1	156			254	1351	316	1670	114	606	77	408	3
0	185			320	1703	470	2150	144	764	97	513	2
00	220	4-11-13		470	2150			182	964	122	648	1
000	262	F. C. S.		510	2710			230	1217	156	817	0
0000	312			[illegible]	3420			290	1534	196	1030	00

Iron wire six times resistance of copper. Figure one-sixth the power or one-sixth the distance.





The diagrams are self-explanatory, three being for copper wire transmission or distribution and one for iron wire. The vertical lines show watts to be delivered, the oblique lines, the voltage, distance and number of phases, together with the percentage loss, while the horizontal lines show the size of wire. The operations are reversible so that any desired factor may be determined when the others are given.

The accompanying table gives weights and carrying capacities.

TELEPHONE STATISTICS.

Interesting statistics from the annual report of President Vail to the stockholders of the American Telephone and Telegraph Company are as follows:

Fourteen billion, four hundred million telephone conversations in a single year, 1911, is the estimate given by President Vail, based upon the last available figures. For the American Telephone and Telegraph Company and its connected lines, that is, the Bell System, there were approximately 8,172,000,000 telephone conversations in 1912, as against 7,770,000,000 in 1911. In the Bell System there are altogether 7,456,074 telephone stations, an increase over last year of 823,449 stations. That the telephone has indeed become a household necessity in the United States is indicated by these figures, and by the further fact that there are now 70,000 towns, cities and hamlets from which telephone messages may be sent. This is 5000 more than the number of postoffices in the United States; 10,000 more than the number of railroad stations, and nearly three times the number of regular telegraph offices.

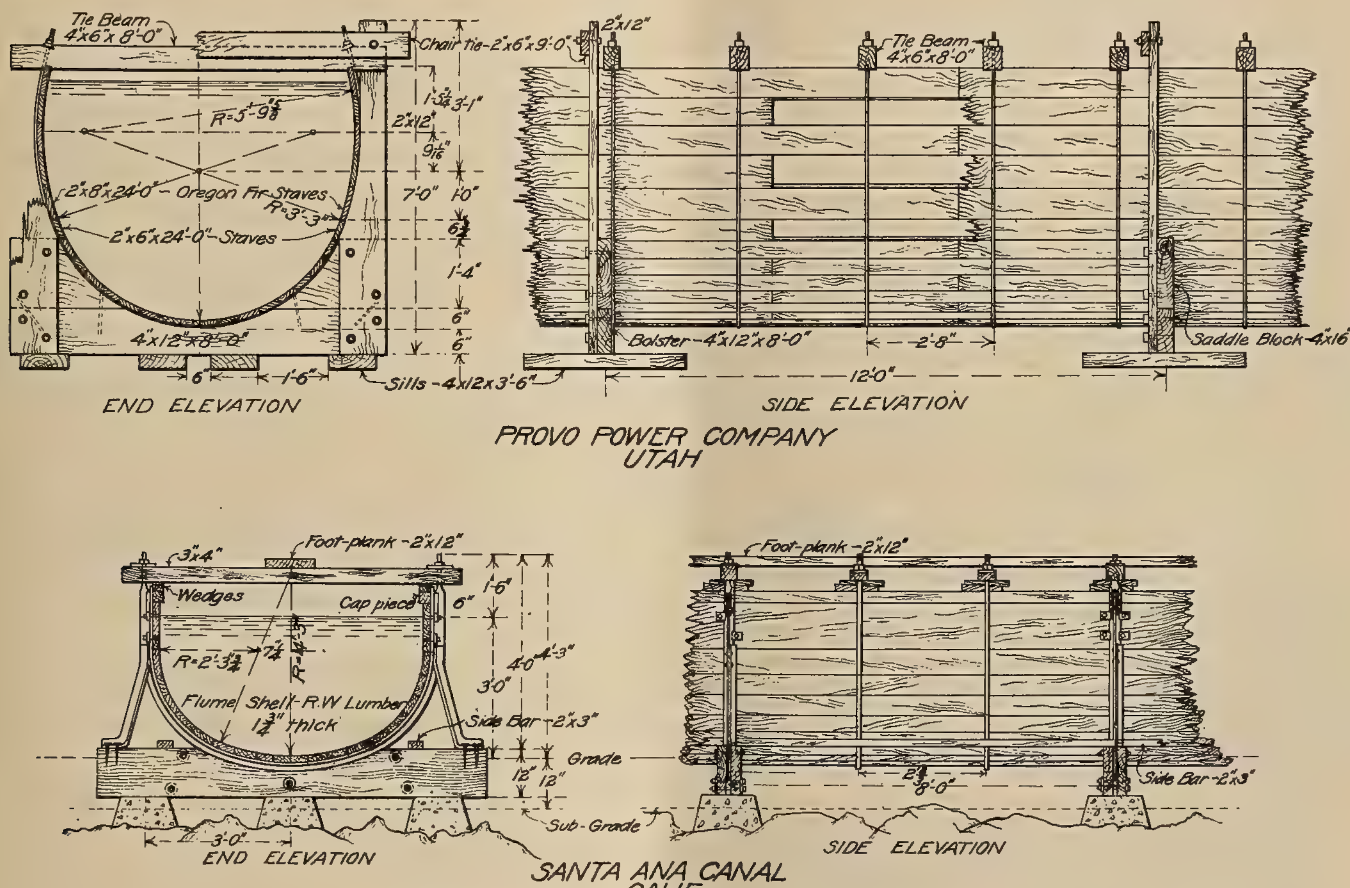
ELECTRICAL PUMPING AND IRRIGATION

WOODEN AND METAL FLUMES.

BY B. A. ETCHEVERRY.

Economic Design of Wooden Flumes.

The most economic flume is the one which will give the lowest total cost of flume lining, framework and substructure. The cost of framework can be decreased by spacing the side posts far apart, but this increases the cost of the lining. The economic relation is obtained by using a thickness of lining which will give the minimum cost for flume lining and framework. The minimum thickness of lining is about 1½ in. The cost of trestle work and foundation is decreased by making the span between bents as large as feasible but this increases the cost of stringers. The economic span is smaller for a low trestle than for a high trestle.



Details of Wooden Stave Flumes, Utah and California.

Semi-circular Wooden Stave Flumes.

This type of flume resembles the stave pipe. The flume box is formed by wooden staves. Two types have been used. In one type the flume is built in sections 8 ft. long. The ends are supported on T irons curved to coincide with the flume. Between the supports the staves are bound by 2⅝ round steel rods fastened by means of nuts to two horizontal tie beams which rest on the top edges of the flume box. At their ends the staves are tightened by means of wedges driven between the tie beams and the edges of the flume, and throughout the middle portion they are tightened by cinching the nuts of the two iron rods. The other type is made continuous, the staves being connected at their ends by metallic tongues and are broken-jointed. Half-inch steel bands pass through tie beams and the flume can be made water tight by screwing up the nuts at the ends of each threaded band. The flume is supported on wooden chairs placed 10 to 12 ft. apart. Each chair consists of a bolster, two vertical pieces curved by band sawing to suit the exterior of the flume, and a straight tie beam.

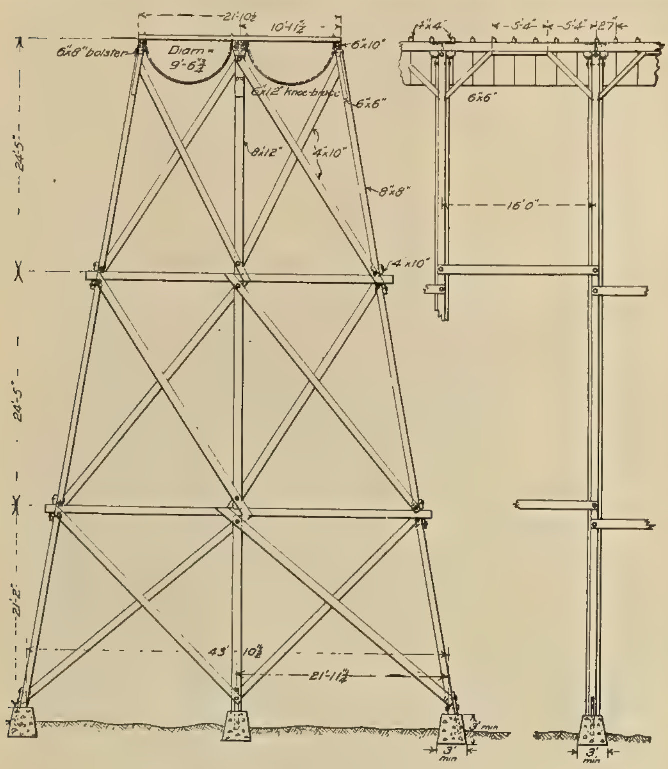
The semi-circular flume has some advantages over the rectangular flume. It is easily adjusted to curves; it can be made water tight by screwing up the nuts at the ends of the rods and it has fewer supports because each 12 ft. length acts as a girder. From experiments on the carrying capacity of semi-circular flumes the coefficient of roughness has been found to be equal to about .012.

Steel Flumes.

The steel or metal flumes used for irrigation are of two types: rectangular and semi-circular.

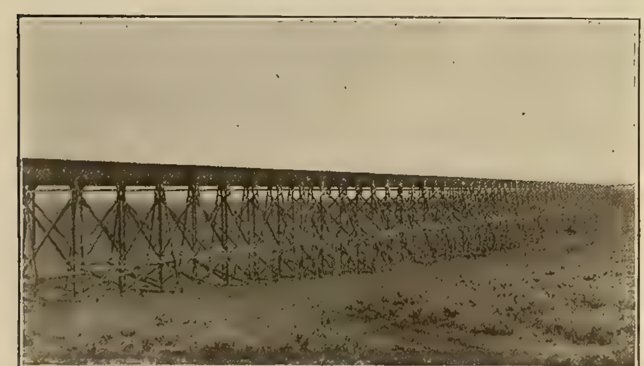
The rectangular form has been used only in a few cases. The waterway or flume box is formed by the two sides, which are plate girders, and the floor. The side girders are designed as for a plate girder bridge.

They consist of a web strengthened with flange angles and web stiffeners. These girders carry the load between spans. The floor is made of a slab connected to the lower flange of the girder. It consists of a plate strengthened with angles or tees. The substructure usually consists of masonry piers or steel trestle bents.



SHEET METAL TWIN FLUME
MEDINA IRRIGATION CO.
TEXAS

The semi-circular metal flume is more common than the rectangular flume. During the last few years it has become a very popular type of flume because of its cheapness, water-tightness, and ease of construction. The flumes are made of metal sheets curved in a semi-circular form with a bead or corrugated groove rolled in each edge of the sheet. The sheets are put together by means of an interlocking joint formed by overlapping the edges which fit over each other. The joint is made tight by means of a curved rod which fits on the outside of the corrugated groove and a curved beveled bar or small channel on the inside. The steel rods carry the weight of the flume. The ends are threaded for nuts and pass through the carrier or tie beams which are supported on stringers usually about 16 ft. long. The stringers rest on trestle bents to which they are connected by bolts. By screwing the nuts the outside rod is drawn firmly against the flume and the channel or bar presses on the inside making a water-tight joint.



Twin Falls, Salmon River Land & Water Co., Idaho.

[Galvanized Steel Flume, 1305 ft. Long—40 ft. High in Center. Flume is 10.2 ft. in Diameter, Capacity 200 Second ft. Sills are Anchored to Concrete Footings.]

There are several makes of flume on the market, of which the best known are: (1) the Maginnis galvanized steel flume, sold by the Maginnis Flume Company, Ideal Building, Denver, Colo.; (2) the Hess flume, sold by the Hess Flume Company, First National Bank Building, Denver, Colo.; (3) the Lennon flume made by the Lennon Flume Company of Colorado Springs, Colo. The construction is very similar, differing only in the method of forming the interlocking joint. The Maginnis flume has a small channel which fits on the inside of the flume at each joint, while the Hess flume has a beveled bar which fits in the groove. The flumes are made in sizes ranging from a diameter of 8 in. to 13 ft. 5 in. The capacities given in the catalogues are for the flumes running full with no freeboard or clearance between the water level and the edges of the sheets. The purchaser should consider this and obtain a flume of ample capacity. The Hess flume has a greater capacity than the same size Maginnis flume because of the interlocking joint. The inside channel of the Maginnis flume projects above the inside surface of the metal sheets, while the outside surface of the beveled bar of the Hess flume is flush with the inside surface of the sheets. The metal used is either galvanized iron or steel sheets or some metal such as ingot iron or Toncan metal. These last two metals are a grade of iron in which all impurities found in ordinary steel or iron have been eliminated as far as possible. It is claimed that the resulting metal has the property of resisting rust or corrosion much better than the common or galvanized iron and steel.

As regards economy, the first cost of a metal flume will be higher than that of a wooden flume, but its greater durability as well as its water tightness will make its ultimate cost lower.

Reinforced Concrete Flumes.

Reinforced concrete flumes have recently been constructed on some of the projects of the U. S. Reclamation Service and on other projects in this and other countries. The flume box of a reinforced concrete flume is generally rectangular and is supported on a substructure of piers, posts or arches. A bench flume of reinforced concrete would consist of two retaining walls and a floor. The flume box may be of the following types depending on the method of design.

1. The sides are designed as cantilever walls to resist the water pressure.

2. The sides are tied at the top by means of tie beams made of reinforced concrete or of steel shapes, and vertical reinforcement is placed in the sides to obtain the action of side posts or beams at each tie beam, corresponding to the framing of a wooden flume. The sidewall between the vertical reinforcement is designed as a slab whose span is equal to the distance apart of tie beams.

3. The sides are tied at the top with tie beams placed farther apart than in previous case and are designed as vertical slabs connected at their lower end to the floor and at their upper end to a reinforced concrete beam formed as part of the sides. The span of the beam is the distance apart between the tie beams.

The method of design depends also on the substructure. When the flume is supported on columns or piers the flume box is carried over the span usually by designing the sides as girders and reinforcing the top and bottom accordingly by supporting the flume on reinforced concrete beams. The floor is designed as a floor slab supported at the side walls or on the beams. The first form is illustrated by the Escondido flume, which, however, is much too heavily reinforced. The second form combined with the first is illustrated by the Hamiz flume. When the flume is supported on arches the sides are designed only for the water pressure. The piers will be of the same type as masonry bridge piers with sufficient base to distribute the pressure on the foundation. When the piers are in running water the upstream edge of the pier is formed into a cutwater. The posts are reinforced concrete columns and are supported on a masonry base or pier which extends above the maximum flow line. The arches may be of masonry or reinforced concrete and are designed as bridge arches.

STRIKE OF PACIFIC GAS AND ELECTRIC EMPLOYEES.

All electrical workers, firemen, machinists, boilermakers and gasmakers (except in San Francisco) in the employ of the Pacific Gas and Electric Company went on strike at 8 A. M. May 7. John A. Britton, vice-president and general manager of the company, issued the following statement:

"The Pacific Gas and Electric Company and its predecessors in interest have for over twenty years past been working in harmony with all the labor organizations affiliated with it, and have cheerfully met all demands for increase of wages and decrease of hours of workingmen, and has granted other conditions for their betterment. Agreements with the gas workers, electrical workers and firemen expired by limitation during the present year. No agreement was in force with machinists. In February, 1913, the Light and Power Council of California was organized, embracing boilermakers, stationary firemen, machinists, steam engineers—L. U. 171, gas workers (except San Francisco), and electrical workers, and subsequently on March 6, 1913, presented to the Pacific Gas and Electric Company a joint agreement with above organizations covering all of the territory of the company.

"The Pacific Gas and Electric Company on March 31, 1913, declined to recognize the Council, and so notified it, but on April 7, 1913, reconsidered its determination and agreed to recognize and enter into negotiations with said Council. Subsequently, on April 14, 1913, and continuing thereafter until April 25, 1913, conferences were had with representatives of the Light and Power Council and representatives of the company in discussion of the agreement submitted.

"On Monday, April 28, 1913, a counter proposition was submitted by the company which offered a substantial increase of wage and betterment of working conditions, and an allowance of one day's rest in seven to all monthly employees with full pay, and one day's rest in seven to all other employees as well, and on Tuesday, May 6, 1913, in conference held between the Light and Power Council and the company the proposition of the company as submitted was declined, and the company notified that unless the agreement as submitted by the Light and Power Council was accepted a strike would be called.

"The company then submitted to the Light and Power Council a proposition to leave to arbitration the question involved between the company and the council, which proposition to arbitrate was declined by the Light and Power Council.

"At a conference lasting from 2 o'clock P. M. to 6:15 o'clock P. M. on Tuesday May 6, 1913, it was brought out that the company and the council agreed upon the rate of wage, hours of employment and conditions of work insofar as the gas workers, machinists and boilermakers were concerned, but could not agree upon the rate of wage, hours of employment and conditions of work submitted by the electrical workers and firemen, and thereupon the conference adjourned, the company refusing to accept, as a whole, the agreement submitted, as it could not accede to the demands of the electrical workers and the firemen.

"At 9:30 o'clock P. M. of Tuesday, May 6, 1913, the company was notified by the council that a strike would be called at 8 o'clock A. M. on May 7, 1913, involving the gas workers in all the territory (except San Francisco), all firemen, machinists, boilermakers and electrical workers throughout the entire territory of the company, although the schedules submitted by the gas workers, machinists and boilermakers were satisfactory to both parties.

"The Pacific Gas and Electric Company declined to accept the demands of the Light and Power Council insofar as the schedules of the electrical workers and firemen were concerned, and for the following reasons:

"The rate of wage submitted was a demand in excess of any agreement made by the said bodies with organizations similar to the Pacific Gas and Electric Company in the State of California, and the working conditions were more burdensome and onerous.

"The company considers the demands of the Light and Power Council for the electrical workers, and to an extent the firemen, as arbitrary and unjust, and placing a burden upon the company unequal in character, since no other company in the state is requested to operate under like conditions, and the limitation of the company's ability to pay an advance wage and to bear other financial burdens imposed has been reached, and the extent to which the company could go was expressed in an agreement submitted by it in a compromise proposition.

"The company deprecates the privations of consumers that may ensue by reason of the strike declared. It will endeavor to operate its plants insofar as it is possible to do, but may, because of a lack of men, be compelled to shut down some of its plants, and therefore deprive the public of light, heat and power.

"It feels that it is fighting for a principle, and therefore asks the indulgence of the public until this matter is adjusted by the only fair means known, and that is—arbitration.

"The company's attitude in the past toward labor should be sufficient guarantee that it is not declining a reasonable request, but is resisting arbitrary and unjust requirements, not warranted by conditions at present.

"The company is confident that had it been dealing with each organization, separately, it would have had no difficulty in arranging a proper schedule, satisfactory to all parties, with each of the organizations, and that it was prevented from doing so by the arbitrary action of the council in upholding the unusual demands of the minority of the crafts affiliated with the council."

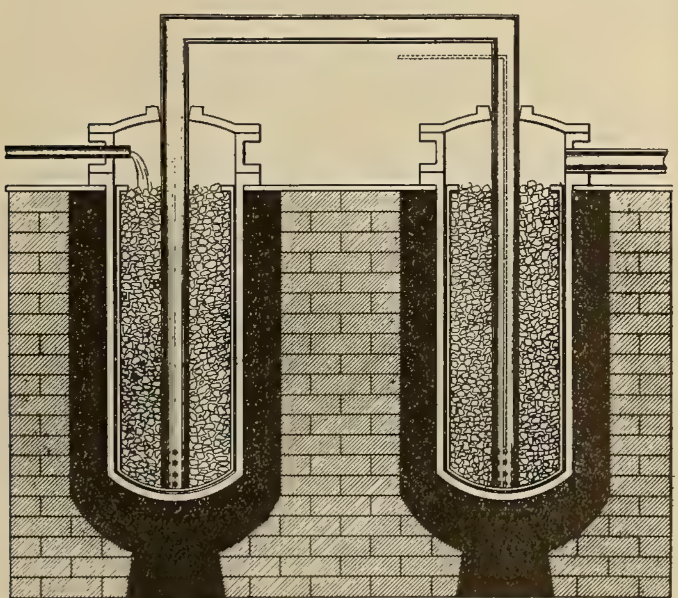
GAS ENGINEERING

THE MANUFACTURE OF OIL GAS.—II.

BY E. C. JONES.

Of all the substances from which gas is made, oil is best suited in every way. It naturally contains every element needed in illuminating gas, and combinations of elements so arranged that it only needs the skilful touch of the chemists to rearrange them into any desired gas without waste. Compared with solid fuel, oil may be more conveniently and cheaply handled, and may be stored in smaller space. The steam or electrically driven pump takes the place of the shovel, wielded by manual labor, as well as every form of mechanically operated coal handling device. The metal oil tank displaces the wooden coal shed, and each cubic foot of oil contains 67 per cent more energy than a cubic foot of coal as stored. A cubic foot of California petroleum contains 1,151,172 British thermal units, while a cubic foot of bituminous coal contains 689,000 British thermal units.

TAYLOR'S OIL GAS APPARATUS 1827



FROM THE "FRANKLIN JOURNAL" PHILADELPHIA, DEC. 1827

The ready adaptability of oil to gas making caused the pioneers of the industry to divide their attention between oil and coal, and many of the early efforts to design apparatus, show that more ingenuity was used in devising means to distill gas from oil than from coal.

An example of this is the description of Taylor's Patent Gas Apparatus (for making gas from oil) in the Franklin Journal, Philadelphia, 1827. This was nine years (1836) before gas was supplied to the inhabitants of Philadelphia. It is interesting to quote from this old journal to better understand the slowness with which gas-lighting was introduced:

"As experience has demonstrated that gas lights may be advantageously substituted for the former methods of obtaining artificial light in a greater number of cases, and particularly in cities, and in many extensive manufactories, the subject has become one of high interest. New York and Baltimore already enjoy the benefits of this improvement; and we apprehend that Philadelphia will not long lag in the rear, that hyper-prudence, which is thought to be one of her characteristics, to the contrary notwithstanding."

The Taylor method of making oil gas consisted of two vertical iron retorts set in a single furnace. These retorts were furnished with a mouth piece and luted lid at the top end. A metal pipe passed through each lid to near the bottom of the retort, and the lower end of each pipe was perforated with holes. These pipes were connected together at the top so that the retorts were used in tandem. The retorts were filled with broken bricks. This is the first recorded use of checker-brick.

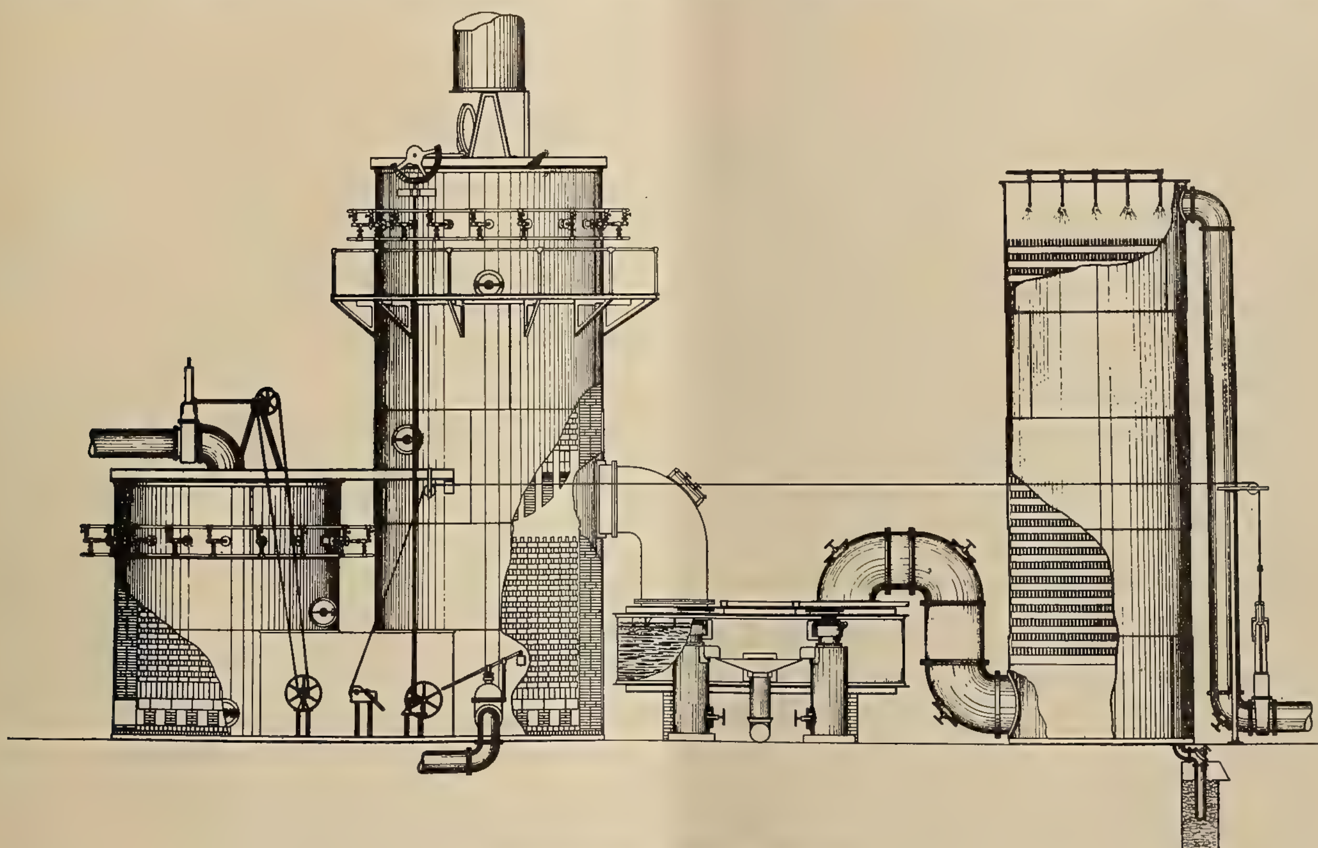
To make gas, the retorts were externally heated until the broken bricks were red hot. Oil was then admitted to the space above the brick in one of the retorts, and passing downward through the broken brick entered the central pipe through the perforations and passing upward and over into the pipe in the second retort, escaped through the perforations in the bottom of the second pipe and finally passed upwards through the broken brick in this retort and through an outlet pipe in the mouth-piece of the second retort. In this way the oil was gasified. The inventor probably never knew how many essentials of modern oil gas making were included in his invention, and could a plentiful supply of petroleum have been substituted for the sperm oil of those days, it would have changed the history of the gas business.

The city of Edinburgh, Scotland, was lighted by oil gas in 1824, when the Edinburgh Oil Gas Company was established with Sir Walter Scott as chairman. The failure of the undertaking plunged this noble and brilliant man into debt from which he never recovered, and the whole of the money received from many of his works was turned over to his creditors. Evidently the time was not ripe for oil gas.

It would require a volume to record the oil gas processes invented and promoted between the failure of the Edinburgh Company and the water gas invention of Prof. Lowe. These depended on external heating of retorts of various shapes for vaporizing or gasifying oil. Horizontal retorts containing nests of pipes were used for making oil gas for enriching coal gas, and a combination of vertical and horizontal retorts known as the "boot leg process" (from its similarity in shape to a boot) was used to manufacture water gas containing less than ten per cent of carbonic oxide. These boot leg retorts were filled with fragments of limestone with the expectation that the resulting calcium oxide would dissociate steam and absorb carbonic acid gas. The gas made in this way was a primitive form of oil gas varying in its composition with the temperature of the retort, and little,

if any, steam was decomposed in passing through the lime.

During the progress of experiments with this process it was demonstrated that the oxygen of steam will not unite with carbon while it is combined with hydrogen in the form of hydro-carbons. Carbon must be in a free state and heated to incandescence before it will dissociate steam and form carbonic acid gas or carbonic oxide. All of these processes relied upon the treatment of oil under comparatively low temperatures for its destructive distillation, and the conduction of heat through the refractory materials of retorts was both wasteful and ineffectual. The use of oil in the internally heated apparatus of Lowe for the enriching of water gas did not contemplate the breaking down of oil into diluent gases and the cracking of hydro-carbons into hydrogen and lampblack. The temperature now maintained in the superheaters of carburetted water gas sets seldom exceed 1400 degrees F., which is about 1200 degrees F. less than the temperature employed in breaking down oil in the early oil gas apparatus.



Sixteen-Foot Jones Oil Gas Set.

The first step in the evolution of the present method of making oil gas was the patent issued to L. P. Lowe, then of Lynn, Mass., on June 18, 1889, for "Apparatus for the Manufacture of Hydro-carbon Gas." This apparatus consisted of "chambers lined with refractory material and each having an open-work filling of refractory material." In other words generators filled with checker brick and internally heated by combustion of oil and air, thus storing heat in the checker brick to be subsequently used for breaking down the oil during the gas making period.

At the time of the invention it is safe to say, that there was no place in the world, in proximity to a market for the gas, where the price of oil was low enough to permit of the economical commercial success of the process. In that year the entire production of oil in California was only 303,220 barrels. The invention was in anticipation of its usefulness by many years for it was not until 1899 that the first crude oil water gas works was built in California, and the first installation for lighting a large city was started in Oakland in 1902. The apparatus employed consisted of two cylindrical shells lined with fire brick and filled with checker brick. The checker brick were heated by oil injected under pressure with steam, and a blast of air for combustion. In radically departing from all methods previously used for making gas from oil, it was thought to be necessary to subject the oil to extremely high heats, but this destroyed a large portion of the oil, and reduced the candle power of the gas.

A large amount of lampblack was also produced, as much as 30 pounds to the 1000 ft. of gas was no uncommon yield. Thus the lampblack, by-product, and the gas made from the oil, were nearly of equal weight. It was supposed that lampblack was a necessary result of making oil gas, and that the lampblack might be used within the generator for dissociating steam and producing blue water-gas.

It was soon discovered that lampblack was deposited by the destruction of hydro-carbon gas, and that the amount of lampblack produced and the amount of free hydrogen in the gas were closely connected. Samples of early oil gas contained as much as 62 per cent of hydrogen, and the carbonic oxide content was 3 per cent, which is evidence that little, if any, of the steam admitted to the generator was decomposed by lampblack.

In the development of a standard oil gas process it became necessary to discard the use of arches over combustion chambers, because they would not stand the intense blow-pipe effect of the oil fire. The area of the checker brick was increased and means were provided for controlling the heat in different parts of the generators.

These improvements reduced the amount of lampblack made, and the percentage of free hydrogen in the gas. The quantity of oil used to make the gas was cut from over 12 gallons to less than 8 gallons per thousand cu. ft.

The apparatus which now seems to be giving the most satisfactory results in making oil gas consists of two cylindrical shells connected at the bottom by a throat piece, thus forming a letter U, one leg of the U being longer than the other. The shorter of the two shells is known as the "primary" and the longer as the "secondary" generator. These shells are lined with fire brick, and are filled with checker brick. The outlet for gas is placed at about midway the height of the secondary shell, and above this outlet there are a series of arches reaching across the shell to support more checker brick. Air is admitted under pressure for combustion of the oil at the center of the top of the primary shell, and also near the bottom at the side of the secondary shell, this last is called the secandary blast. The outlet for the escape of waste products of combustion is through the top of the secondary shell, and is known as the stack valve.

The oil used for heating the checker brick is sprayed through a number of oil burners on the side and near the top of the primary shell. The oil is pumped to these burners through a ring of pipe extending around the shell, and parallel to this is a ring of steam piping.

The oil for making gas is conducted through separate rings of pipe to separate burners placed near the heating burners on the side near the top of the primary, and there is also a ring of pipe and series of burners for spraying oil for making gas, at the side near the top of the secondary shell.

To make gas for the first time it is necessary to heat the checker brick in both shells to a temperature high enough to ignite oil. This is done by building a wood fire in the primary. Air is then admitted to the top of the primary by opening the blast valve, and oil is then forced through the heating burners under pressure and assisted by steam also under pressure.

The oil burns above the checker brick in the primary, and the heat is transmitted downward through the checker brick and upward through the checker brick in the secondary, the products of combustion passing into the atmosphere through the stack valve.

The process is intermittent, and includes a blowing period and gas making period the same as for water gas. No solid fuel is used as oil is burned completely to furnish heat for the checker brick.

Steam is used for injecting oil, for the purpose of protecting the oil vapor against destruction by overheating, and to add its quota of blue water gas to the oil gas. By this process, gas is made entirely from oil and steam and the elements in the oil and steam provide every element and combination of elements in the gas. The largest oil gas units as used in the cities around the bay of San Francisco are known as 16 ft. sets. The primary and secondary shells are each 16 ft. in diameter, and the set has a rated capacity of 150,000 ft. of gas an hour. If the total amount of oil used to make 1000 ft. of gas is 8 gallons, it is divided between heating and making in about the proportion of 1.3 gallons for heating and 6.7 gallons for making.

The sequence of operations during a blow and run, after the set is in condition to make gas, is as follows:

Heating:

1. Air is blasted into the primary for 3 minutes without any oil.
2. Air is blasted and oil injected into the top of the primary for 7 minutes.

Making:

1. Oil is injected into the primary and top of the secondary for 7 minutes.
2. Steam is injected without oil for 3 minutes. This is known as the purge.)

For the purpose of keeping the checker brick free from carbon accumulations, after every eleven runs there is a long blow, air is blasted into the generator, without oil for ten minutes, after which oil is admitted with the air and the regular heating period of 7 minutes begins.

The oil used should be preheated to as high a temperature as is consistent with the use of steam for heating. It is most economical and satisfactory to use a large oil heater containing enough oil for at least two runs, and heated by exhaust steam from the blower engines.

The burner used for spraying oil should be so adjusted that there is no change in the velocity of the stream of oil and steam after it is atomized, and the oil should be projected into the generator as oil fog. It is then in the best condition to be quickly heated and cracked by the radiant heat in the chamber at the top of the primary and converted into fixed oil gas by contact with the hot surfaces of the checker brick.

The temperature of the chamber at the top of the primary at the beginning of the run, is from 1800 to 2100 degrees F., and this falls during the gas making period to about 1200 degrees F., it is then restored during the blowing period. The range of temperatures in the checker brick of the secondary generator is from 1200 degrees to 1800 degrees, F. during the gas-making period.

By exercising care in atomizing oil and regulation of the heat of the checker brick, the amount of lampblack has been reduced from 30 pounds to 10 pounds of dry lamp black per 1000 cu. ft. of gas, and the hydrogen content of the gas has been reduced from 62 per cent to about 45 per cent with an almost corresponding increase in marsh gas. This has resulted in a substantial reduction in the amount of oil used to make the gas, and the gas is of greater heating value.

There have been quite recently some revolutionary improvements in oil gas making. It was discovered that if oil is caused to be dissociated in a hydrogen atmosphere instead of in an atmosphere of its own vapor there is practically no breaking down of hydro-carbons into free carbon, (or lampblack) and

free hydrogen. This means that oil gas can be made without producing lampblack, and practical results with an apparatus provided with a gas chamber show a production of about 5 pounds of lampblack per 1000 cu. ft.

In this new apparatus the oil for heating is not burned directly above the checker brick in the primary, but is consumed in a separate heating chamber at the top of the primary, this chamber also contains a few courses of checker brick. In this way it is possible to heat the checker brick in the primary and secondary very evenly and with no over-head incandescent spots.

After a generator is heated by this method, steam is turned into the upper combustion chamber and is superheated in passing through hot checker brick.

ANALYSES OF GASES

KIND OF GAS	Illuminants C_nH_{2n}	Marsh Gas CH_4	Hydrogen H_2	Carbonic Oxide CO	Carbonic Acid CO_2	Oxygen O_2	Nitrogen N_2	Sp. Gr.	Candle Power	B.T.U.
COAL GAS MANCHESTER 1857	6.46	34.90	45.58	6.64	3.67	0.00	2.75	.435	16.0	683
"BLUE" WATER GAS	0.00	2.20	50.00	39.75	4.60	0.35	3.10	.537	NIL	322
CARBURETTED WATER GAS ANTHRACITE COAL	13.00	16.00	32.00	29.00	4.50	0.50	5.00	.630	24.0	641
EARLY OIL GAS (LOWE)	6.20	25.60	62.40	3.00	0.20	0.40	2.20	.303	18.6	624
OIL GAS OAKLAND	5.00	26.30	55.00	7.70	1.80	0.10	4.10	.375	18.4	598
OIL GAS POTRERO	7.01	34.64	39.78	9.21	2.62	0.16	6.58	.482	19.69	680
CARB. WATER GAS LAMPBLACK	16.50	32.80	24.60	13.70	6.20	0.20	6.00	.647	28.5	814
SAN FRANCISCO POTRERO MIXED	9.80	31.00	38.90	11.00	4.40	0.40	4.50	.516	23.0	700
NEW PROCESS METROPOLITAN	6.00	40.40	41.40	5.30	2.00	0.10	4.80	.440	19.60	714
NATURAL GAS PENNSYLVANIA	0.31	92.60	2.18	0.50	0.26	0.34	3.61	.565	NIL	1000
NATURAL GAS STOCKTON, CAL.	0.00	76.10	0.00	0.00	0.20	0.40	23.30	.655	NIL	816
NATURAL GAS SACRAMENTO, CAL.	0.00	80.00	0.00	0.00	0.00	0.00	20.00	.638	NIL	858
PINTSCH GAS	38.10	57.70	3.40	0.50	0.00	0.00	0.00	.699	60.82	1390
OIL PRODUCER GAS	1.60	4.60	4.60	15.40	5.80	0.20	67.80	.942	NIL	150
PRODUCER GAS MOND GAS	0.00	2.00	24.3	13.8	13.9	0.00	46.0	.820	NIL	153
PRODUCER GAS DOWSON GAS	0.31	0.31	18.73	25.07	6.57	0.03	48.98	.837	NIL	161

Ordinary illuminating oil gas taken from the gas holder is forced under pressure into the top of the primary and the oil for gas making is sprayed into this gas atmosphere.

This catalytic gas is simply borrowed for the purpose and due credit is given for it. Its chemical constituents are re-arranged and its volume is increased, but its heating value is not impaired. By this method of protective heating of a generator, it is possible to maintain the temperature of the checker brick with only a variation of 300 degrees F. between the extremes of blow and run. The accompanying table gives the chemical composition of the new oil gas.

After oil gas leaves the generator it passes into the wash box, which is a hydraulic seal to prevent the return of the gas to the generator. The wash box also serves to separate the lampblack from the gas by a thorough system of washing and the lampblack held in suspension in water overflows from the wash box to the lampblack separators.

The wash-box now generally used is an oval steel tank with flat top and bottom, provided with an inlet dip pipe at one end of the top, and an outlet pipe for gas at the other end. There are no partitions or baffle plates used and the space within the box is clear.

Two large overflows on the side of the wash-box carry away the lampblack and water. A self cleaning principle applied to this wash-box consists in constant agitation of the water in the box. This is done by dividing the main water supply into a number of small streams conveyed by pipes to within a few inches of the bottom of the box. The water is thus forced downward to the bottom of the box and rises to the overflows. The lampblack is washed out of the gas by this turbulent water, and is carried out of the box before it has an opportunity to settle.

The average temperature of the water entering the wash-box is 61 degrees F. and the average temperature of the water leaving the wash-box is 129 degrees F. The amount of water used is about 46 gallons per thousand cu. ft. of gas. When it is available, salt water is used in the wash-box, and also in the scrubbers without the slightest injury to the gas, and although the temperature of the water is considerably raised in both the wash-box and scrubbers, there has never been any trouble from salt incrustation.

The average temperature of the gas at the outlet of the wash-box is 142 degrees F.

The water and lampblack flow from the wash-box through open drains to the lampblack separator. It is necessary to thoroughly scrub oil gas, and more water is used for scrubbing it than either coal or water gas on account of the finely divided particles of lampblack held in suspension in the gas, and these must be completely removed before the gas enters the purifiers. A small quantity of oil tar is also removed from the gas by scrubbing. The scrubber best suited to the treatment of oil gas is the cylindrical steel tower filled with wooden trays, as described in the lecture on "Purification of Coal Gas." The gas inlet is at the bottom and water is sprayed on the top of the trays so that the gas and water flow in opposite directions.

It is customary to use three of these scrubbers for each 16 ft. set, and the amount of water used in each scrubber is approximately 15 gallons per thousand cu. ft. of gas, or 45 gallons per thousand cu. ft. for the complete scrubbing of the gas.

In purifying oil gas the method is the same as that used for the purification of coal or water gas. Oxide of iron is the cheapest and most satisfactory material for this purpose, and if the amount of sulphur contained in the oil is less than one per cent, there is no difficulty in removing all the sulphuretted hydrogen and reducing the sulphur compounds contained in the crude gas to 8 grains per hundred cu. ft. of gas.

When oil containing excessive amounts of sulphur are used for making oil gas, it has sometimes been the practice to re-heat the gas, by passing it

through an auxiliary generator containing heated checker brick. This re-heating process converts the sulphur compounds into sulphuretted hydrogen which is removed in the usual way by iron oxide in the purifiers.

There is never any ammonia present in oil gas as it leaves the generator, although ammonia is formed from the oil in the initial stages of the process, and is subsequently destroyed by contact with the highly heated checker brick, and appears in the gas as hydrogen and nitrogen. The only by-products are lampblack and a small quantity of tar. The lampblack is recovered by separation from water in large wooden separators arranged in two sections by partitions running lengthwise through them to permit the alternate cleaning and use of the sections.

These separators are provided with transverse partitions and skimmers, and the water containing lampblack passes under the skimmer and over the partitions. The specific gravity of lampblack and water is so nearly alike that the separation is necessarily slow, but the particles of lampblack gradually settle through the water to the bottom of the tank. It has been demonstrated that to thoroughly separate the lampblack from the water a large area of separator is required and a consequent slow speed of flow of water through it.

The amount of oil tar made is so inconsiderable that it is customary to mix it with the lampblack for use as fuel, or as a binder to assist in briquetting the lampblack.

In some of the larger plants there have recently been installed mechanically operated dewatering and drum filters for separating lampblack. This is an application to a new use of apparatus used in connection with the cyanide process for treating gold ores. The dewatering filter contains a number of leaves covered with cloth and connected by a rotary valve to a vacuum pump and compressor, which alternately places suction and pressure on each leaf in rotation. This machine treats water from the wash-box containing 3 per cent of lampblack, removing the water and thickening the mixture until it contains 10 per cent of lampblack.

The drum filter, which also uses the vacuum and pressure principle, then receives this mixture and further removes the water until the lampblack scraped from the outside of the revolving drum and falling on a belt conveyor contains 50 per cent of water and 50 per cent of lampblack.

Lampblack in this condition is used as boiler fuel, or after slow draining in a pile is used in water gas generators as a substitute for anthracite coal.

The composition of the drained lampblack ready for use as water gas fuel is as follows:

Volatile matter, including moisture ...	34.15%
Fixed carbon ...	65.80%
Ash ...	0.05%
	100.0 %

The amount of lampblack required as generator fuel per 1000 cu. ft. of gas is about 40 pounds, which with 6 gallons of California crude oil will produce lampblack water gas of 30 candle-power.

Lampblack used in this way in a water gas generator reduces the capacity of the generator when compared with anthracite coal by about half, and to overcome this drawback rotary driers are used for further removing the moisture, and the heated, dry lampblack is then made into briquettes the size and shape of a fire brick. This material compares favorably with other generator fuels and the capacity of the apparatus is nearly normal. Lampblack after it leaves the drier is also made into smaller briquettes for domestic use, and as a fuel it is deservedly popular on account of its extremely low ash content. When ignited it glows until it is all consumed.

The analysis of one of these briquettes after it had been stored for a year was as follows:

Moisture ...	8.5%
Volatile matter ...	10.8%
Fixed carbon ...	79.9%
Ash ...	0.8%
	100.0%

Oil gas is so nearly like coal gas in its chemical composition that it would be impossible to detect one from the other in analyzing samples in the laboratory. To demonstrate this, three analyses are given below in parallel.

Number 1 is an analysis of Manchester Coal Gas.

Number 2 is an analysis made at Martin Station, January 17, 1913.

Number 3 oil gas made at Fresno, Cal., February 7, 1913.

	No. 1. Coal Gas.	No. 2. Martin Oil Gas.	No. 3. Fresno Oil Gas.
Illuminants ...	6.46	6.6	6.2
Marsh gas ...	34.90	35.0	37.0
Hydrogen ...	45.58	42.9	45.6
Carbonic oxide ...	6.64	7.2	5.8
Carbonic acid gas ...	3.67	2.0	2.2
Oxygen ...	0.00	0.2	0.4
Nitrogen ...	2.75	6.1	2.8
	100.00	100.0	100.0
Specific gravity ...	.435	.450	.414
Candle power ...	16.	19.9	20.
British thermal units ..	683	680	685

The candle-power of the oil gas is higher than the coal gas, because of the difference in the quality of the illuminants which yield candle-power. The quantity of the illuminants is nearly the same and in fact a little less in the Fresno oil gas.

The manufacture of oil gas is a live subject of interest to everybody who lives in this land of abundant oil. There is much to be learned about oil gas, and the study of the hydro-carbons, and their behavior at different temperatures will doubly reward the investigator. It is suggested that a study of the effects of heat upon Californiaa crude oil be undertaken with the aid of an electric furnace, which will insure uniform constant temperatures.

GENERAL ELECTRIC COMPANY'S ANNUAL REPORT.

President C. A. Coffin has made the following report to the stockholders of the General Electric Company under date of April 21, 1913, for the year ending December 31, 1912:

Profits from sales		$ 8,107,993.55
Income from other sources		5,002,829.89
		$13,110,823.44
Less interest and discount on debenture bonds	$ 532,087.18	
Dividends paid	6,213,173.92	6.745,261.10
Carried to surplus account for the year		$ 6,365,562.34
The value of orders received during the year was		$102,934,788.00
The amount of sales billed for he year was		89,182,185.80

The foregoing statements include for the first time the business formerly conducted by the Fort Wayne Electric Works, the Sprague Electric Company, and the National Electric Lamp Company. The Fort Wayne Electric Works and the Sprague Electric Company were dissolved and their business merged with that of the General Electric Company during 1911, while corresponding dissolution and merger of the National Electric Lamp Company was effected during 1912.

The competition referred to in last year's report has continued to increase in severity, with the result that the percentage of profit realized from the sales of your apparatus has materially diminished.

The manufacturing facilities of your company have been substantially enlarged in order to provide for the increasing volume of business. The factory floor area is shown as follows:

	Square feet.
1908	7,000,000
1909	7,180,000
1910	8,530,000
1911 (including Fort Wayne, Sprague and Erie)	9,770,000
1912 (including National Lamp Works)	12,160,000

The growth and extent of your company's interests and operations is evidenced by the number of employees in your factories, offices and subsidiary companies, the total number of such employees being in excess of 60,000.

The number of orders received during the year was 466,895, exclusive of the Fort Wayne, Sprague and National Lamp departments. This represents a steady and nearly uniform increase, the number of orders received in 1907 having been 237,006.

The expenditure of $539,956.93 during the year for the purchase of patents, for applications and licenses under patents and for miscellaneous patent expense, has been charged to Profit and Loss, and the patent account remains at $1.

The stocks and bonds owned by your company have a par value of $23,013,764.54 and are carried at a book value of $23,325,070.38 at December 31, 1912. The principal change from last year is the transfer into the various asset accounts of the General Electric Company of its investment in the National Electric Lamp Company.

The book value of current accounts and notes receivable was $26,950,244.90 on December 31, 1912, after making ample provision for possible losses. Of the accounts receivable only $558,224.92 represents the face value of unsettled accounts originating earlier than January 1, 1912. From affiliated, manufacturing and selling companies there was due a total of $4,099,062.64, making a total book value of all accounts and notes receivable of $31,049,307.54.

On January 31, 1893, the book value of the Schenectady, Lynn and Harrison plants was	$ 3,958,528.21
During the twenty fiscal years to December 31, 1912, expenditures have been made, including the cost of the Pittsfield, Erie, Fort Wayne, Sprague and National Lamp plants, aggregating	57,941,511 78
Total	$61,,900,039.99
Written off during the twenty years	37,343,929.40
Book value of above plants at December 31, 1912	$24,556,110.59

A summary of the changes in factory plants account since the last annual report is as follows:

	Net book value Jan. 1, 1912.	Additions during year.	Written off.	National Lamp Works.	Net book value Dec. 31, 1912.
Real estate and buildings	$11,933,028.24	$2,224,974.64	$ 772,197.66	$1,993,317.51	$15,379,122.73
Machinery	7,605,891.06	3,198,952.25	2,628,738.76	1,000,881.31	9,176,985.86
Patterns	1.00	93,255.31	93,255.31		1.00
Furniture and fixtures	1.50	551,787.72	551,788.22		1.00
	$19,538,921.80	$6,068,969.92	$4,045,979.95	$2,994,198.82	$24,556,110.59

On July 25, 1912, the board of directors authorized an issue of $60,000,000 forty year debenture bonds to be sold from time to time as required. Pursuant to this authority, there have been sold $10,000,000 of these debentures bearing interest at the rate of 5 per cent per annum.

During the year the capital stock of your company has been increased by the conversion of $510,000 of the gold debenture bonds of 1907, and also by the issue of $2500 of capital stock in exchange for $3000 of the debentures of 1892.

For the purpose of recouping the stockholders in part for dividends passed or reduced during the years 1893 to 1902, the board of directors on October 11, 1912, declared a stock dividend of 30 per cent out of surplus.

The capital stock of your company as of January 1, 1912 amounted to	$ 77,335,200.00
During the year additional stock was issued:	
In exchange for debentures of 1892	2,500.00
In exchange for debentures of 1907	510,000.00
Stock dividend	23,354,300.00
Total capital stock issued	$101,202,000.00
Reserve against $35,000 debentures of 1892, convertible at 120	29,166.67
Reserve against $211,000 debentures of 1907, convertible at par	211,000.00
Unissued and unappropriated	3,557,833.33
Total authorized capital stock	$105,000,000.00

Quarterly dividends at the rate of 8 per cent per annum have been paid during the year.

The company has no note payable, neither is there any paper outstanding bearing its endorsement.

The certificate of Messrs. Marwick, Mitchell, Peat & Company, chartered accountants, attesting the correctness of the published balance sheet and profit and loss statement accompany the report.

It is an ever increasing pleasure to testify to the ability and fidelity of the members of the administrative, engineering, manufacturing and commercial staffs, and the splendid spirit of co-operation which they have always shown in connection with the company's affairs.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1890.
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CONTENTS

Recent Progress in Oil Gas Manufacture

It is indeed one of the remarkable mile-posts in the progress of the West that L. P. Lowe, now a Western resident and enthusiast, should in Lynn, Mass., invent in 1889 the first apparatus for the manufacture of oil gas which consisted of chambers lined with refractory material, thus paving the way for the gigantic oil gas generators now so familiar in the West. This invention was, however, ahead of its era of usefulness, for in California the petroleum production of that year was but 303,220 bbls. as compared with last year's output of 87,000,000 bbls.

But the inventive genius of this son of the inventor of water gas, the late Professor Lowe, was not to go unrewarded in the annals of useful gifts to mankind, for starting in the city of Oakland in 1902 John A. Britton successfully launched an unprecedented era in oil gas manufacture. Briefly stated this process consists in heating enclosed checker brick to a high temperature—say 1800 degrees F. and then, by shutting off all outlets, heated oil is sprayed in with steam. Upon coming in contact with the highly heated brick the hydrogen and oxygen of the steam become dissociated, the former remaining in the gas as free hydrogen and the latter forming carbon monoxide with the free carbon of the oil. This product is drawn off into a receptacle and then another heating of the cooled brickwork is accomplished and so on intermittently blasting and thus generating oil gas.

E. C. Jones has, however, remarkably improved this process during the last few months at the Metropolitan plant of the Pacific Gas & Electric Company in San Francisco. The bane of the oil gas making industry has been the formation of lampblack, often as much as 30 lb. per 1000 cu. ft. of gas delivered. The lampblack, which is the carbon dissociated from the hydro-carbons of the oil, has consistently appeared until a recent discovery. It has been found that when oil fog, consisting of atomized oil and highly superheated steam, is sprayed into an atmosphere of hydrogen little, if any, of the hydro-carbons of the oil are broken down into carbon or lampblack, and hydrogen. Since it has long been known that the oxygen of steam will not unite with carbon while the carbon is combined with hydrogen in the form of hydrocarbons, it is thus seen that the hydro-carbons of the oil pass over into the gaseous state without change, while the available carbon of the oil, which is now in an incandescent state readily combines with the oxygen of the steam to form carbon monoxide. Thus, the lampblack deposit is kept at a minimum. Under the new process as low as 5 lb. per 1000 cu. ft. of gas is attained. The atmosphere of hydrogen is obtained by passing oil gas already manufactured back again through the gas generators.

Such rapid improvements in an industry scarcely a decade old are indeed a source of congratulation to the utility growth of the West.

The exacting of tolls and rentals for power development must ever be borne with scoffing and chafing by Western men. That those directing the issuance of permits for power development on the public domain should, on the other hand, issue free these permits to municipalities desiring to engage in power enterprises makes the problem again one of considerable discouragement to all those truly interested in seeing our Western water powers made of maximum service at the earliest date possible. The tendency of the age is unquestionably toward public ownership of utilities. Where wisely exploited and judiciously handled by enlightened, public-spirited business men such procedure may at times prove the best. Various municipalities have, however, permitted in their respective communities, millions of dollars to be invested by private enterprise, which deserves a fair and equitable treatment. So long as the people control and regulate the rates to be earned, this self-same people if engaging in competition, should in equity be restrained as far as possible to compete on the same basis as the privately owned competitor.

Partiality toward Municipal Operation

The new series of permits of the Department of the Interior, alluded to above, are as yet of too recent origin to bring specific citations to prove the injustice of such procedure. It is to be hoped, however, that the matter may not be of such ironclad cast that a modification is impossible.

Again, in Southern California, the citizens of Los Angeles should be equally restrained and regulated in the sales of water to neighboring communities, so far as rates are concerned in the same manner that any other utility company is handled. On the other hand, in the Hetch-Hetchy grant for San Francisco's water supply, now before congress, it would seem that the bill should be modified so that the municipality may be enabled to sell water or power in fair and open competition should the same be found profitable.

In the gigantic municipal water projects in the West, economy and efficiency require development on a large scale, often in excess of the immediate demands of the city. Public interest requires that all available water be put to beneficial use as rapidly as demand for it arises. When a city finds it thus imperative to go into the open field as a competitor, the issue should be clean and clear cut without undue partiality or favoritism being given it. It would seem, too, that at all times before entering a district or community served by existing power companies an opportunity should first be given such existing utility companies to take over the power supply or the municipality take over the existing lines at a reasonable wholesale figure in order that costly reduplication of equipment and human effort may not occur. Present distribution systems are now of such gigantic costs that the people, who must eventually pay the additional costs, would do well to heed at all times the baneful and wasteful efforts of reduplication.

And finally if there must be open, free-for-all competition by a municipality and its privately owned utility companies, it is to be hoped that all power originating on the public domain may be obtained by privately owned and competing municipally owned undertakings on the same basis of governmental tolls, if tolls there must be.

The dictionary defines the word "fault" as being "a slight offense." There are many of these "slight offenses," however, that prove the pest and trial of the operating engineer's existence. In large cities where a major portion of the distribution is accomplished in underground ducts, "fault-finding" becomes an art to be ambitiously sought after far more assiduously than its usual connotation suggests to the thinking mind. The two principal faults encountered in underground distribution work are the "ground" and the "short." As is generally known cable failures are often due to an injury to the lead covering. Thus, moisture is allowed to enter the insulation and its insulating qualities are consequently reduced by permitting the current to go to the ground, producing a fault known as a "ground" or to go by a short path from conductor to conductor, which is known as a "short."

Location of Faults

When it is remembered that only a few feet in several hundred is visible to the eye of the testing engineer, some means by which a fault may be readily located is a matter of great economic importance. Telephone cables are readily open to computation by the simple application of the well-known Wheatstone bridge. When it is remembered, however, that due to the low resistances of power cables an error of one foot in telephone work would, on the same basis of comparison, mean 150 ft. in an underground power cable of common practice, it is readily appreciated that more refined methods are necessary in computation. Especially is this true when we consider that terminal and binding resistances though infinitesimal in importance for telephone work, loom up as barriers in power fault finding, if proper means be not taken to compensate or illuminate them.

Beginning with this issue the Journal is pleased to call the attention of its readers to a series of articles which will appear from time to time by Mr. Clarence Gaines. Mr. Gaines is a technical engineer of high standing and has evolved splendid practical modification of current practices in underground cable testing in San Francisco, where he is employed as cable testing expert for one of the largest hydroelectric companies of the West. We commend his technical writings on this subject to all interested in underground cable testing.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Ed. Watkins, proprietor of the Home Electric Company, Tacoma is in the East on business.

Paul M. Lincoln, engineer for the Westinghouse Electric & Manufacturing Company, is at San Francisco.

H. A. Lardner, Pacific Coast manager for J. G. White & Company, is making a brief trip to New York City.

D. L. Huntington, president of the Washington Water Power Company of Spokane, Wash, is at San Francisco.

G. O. Muhlfeld and **Howard L. Rogers**, vice-presidents of the Stone & Webster Construction Company, are at San Francisco.

M. Ramsdell, sales manager, Puget Sound Traction, Light & Power Company, of Seattle, is taking a six-weeks vacation trip through the East.

H. H. Hornsby, manager of conduit and supply sales for the Sprague Electric Works of the General Electric Company, is at San Francisco.

B. W. Collins, superintendent of electric works for the city of Tacoma, recently made an examination of the Hebb power site on White River.

G. I. Kinney, Pacific Coast manager for the Fort Wayne Electric Works of the General Electric Company, has returned to San Francisco from Seattle.

J. M. Laughlin, general salesman for the Westinghouse Electric & Manufacturing Company, Seattle, spent a few days in the Wenatchee country recently.

M. A. Oudin manager foreign department of the General Electric Company, passed through San Francisco this week on his return to Schenectady from the Orient.

W. E. Harring, formerly with the U. S. Forestry Service, has just joined the force of the Puget Sound Traction, Light & Power Company at Seattle, as industrial agent.

A. J. Bowie, Jr., manager of the Bowie Switch Company, has returned to San Francisco from a trip over the lines of the Southern Sierras Power Company, from Riverside to Bishop.

Arthur Gunn, president of the Wenatchee Valley Gas & Electric Company, at Wenatchee, Washington, announces that the company is installing a gas plant and laying service mains.

V. H. Reineking is at Port Angeles, Washington, as resident engineer for the Olympic Power Company to make plans required for the reconstruction of this company's dam across the Elwha River.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, and **A. B. Saurman**, Pacific Coast manager for the Standard Underground Cable Company, are making a motor trip through the coast counties of central California.

E. J. Barry, electrical engineer for the St. Paul & Tacoma Lumber Company, Tacoma, is to make a series of tests on the electric logging equipment on the Potlatch Lumber Company's holdings at Elk River, Idaho. This equipment was installed by Mr. Barry.

H. V. Carter, president of the Pacific States Electric Company, and **C. C. Hillis**, manager of the Electric Appliance Company, are representing the electrical industry in the boosters excursion of the San Francisco Chamber of Commerce throughout California.

O. D. Street, at one time in charge of telephone sales for the Western Electric Company at San Francisco, and **E. W. Rockafellow**, formerly general supply sales manager for the Western Electric Company, have been appointed assistant general sales managers for the company.

H. B. Zimmerman, who has been general manager of the Grays Harbor Railway & Light Co., Aberdeen, Wash., for the past two years, has been transferred to the New York office of the Federal Light & Traction Cc. on special work. He will be succeeded by **P. A. Bertrand**, formerly of Jefferson City, Mo., who will take up his duties about June 1st.

Fifty engineering students of the Oregon Agricultural College visited Portland, Thursday, May 1st and visited various points of interest in and about Portland. The membership of the party was made up by students in the Electrical, Civil and Mechanical Departments, The party was in charge of Professors, Hildebrand, Shepard and Skelton; Messrs. Edgecomb and Rosencrantz. The city engineering department took charge of all the civil and mechanical students and took them to various points of interest in their line of work, while the electrical students visited the Bull Run power plant of the Portland Railway, Light & Power Company, both telephone exchanges and various power plants about the city.

MEETING NOTICES.

Electrical League of Southern California.

At the regular luncheon of the Electrical League of Southern California at the Angeles Hotel, on May 6th, Mr. Ira J. Francis of John A. Roebling Sons Company, gave an interesting talk on "Manufacture of Wire."

Portland Section N. E. L. A.

At the regular meeting of the Portland Section of the National Electric Light Association on May 6th, C. R. Wallis of the General Electric Company showed a series of lantern slides on the "Use of modern units in display and ornamental street lighting."

Oregon Society of Engineers.

At the regular monthly meeting of the Oregon Society of Engineers in the rooms of the Oregon Technical Club, on May 8th, Mr. Jos. N, Teal, chairman of the Oregon Conservation Commission, spoke on the subject of "Conservation." Details of the excursion to Eugene on May 17th were also announced.

Electric Development and Jovian League.

The league was favored with an address by Mr. Geo. H. Kelley, general manager of the Baker Electric Company, of Cleveland, Ohio, at this week's meeting. Mr. Kelley took as his subject "Electricity and Its Application to the Electrical Vehicle Industry," dealing with much detail and thoroughness on the efficiency of the electric truck in delivery service.

Portland Jovian Electrical League.

G. M. Barker presided at the regular lunch of the League on May 1st, H. L. Voise of the Oregon Society of Engineers giving a talk in the interest of Higher Education in Oregon. A. C. McMicken and George Sailor were appointed a committee to arrange for Jovian representation on the excursion to the University of Oregon on May 17th. Remarks were also made by T. H. Bibber, Jovian Statesman-at-large.

Seattle Jovian League.

The Pacific Telephone & Telegraph Company played the host at the luncheon of the Seattle Jovian League, May 25. Mr. Meyers, commercial manager, spoke on that phase of the company's business and touched upon the manner in which the company undertakes to handle questions so far as the public is concerned. Mr. Newell, manager of the traffic department of the company spoke of the traffic operators, how the operators are trained, how they are treated and discussed the switchboard work of the company. The U. S. Steel Products Company will handle the luncheon of the league to be given on May 9th.

Tacoma Jovian League.

The Tacoma Jovian League entertained the architects of the city on April 30 at the Olympus cafe. Music was furnished

during the lunch by the ladies' orchestra from the Princess theater. J. R. McRae, Alternate Statesman, and of the Home Electric Company, acted as toastmaster. The league has appointed a standing committee to be known as the "Architects' Information Committee," the duties of which should be to furnish the architects with data from time to time, bringing to their attention such suggestions and such information as should be helpful in improving the standard of wiring. Llewellyn Evans of the Evans Dickson Company spoke of the urgent need of more definite specifications in electrical work and stated that while many pages were given over to specifications for other portions of buildings, the electrical wiring is generally covered by a few lines, leaving many loopholes for the unscrupulous contractor to do his work in a slipshod manner and the reliable houses figuring to give a first class job were generally high. Mr. Collins of the city light department gave a very interesting talk on electrical heating and suggested that all houses and buildings be wired for same, inasmuch as the new rate to be set by the Tacoma municipal central station would be low enough to make heating and cooking by electricity a possibility. The remarks of Mr. Collins were supplemented by a talk from Mr. Turnbull of the General Electric Company, specialist on electric heating. Mr. Cheney of the Washington Surveying and Rating Bureau discussed wiring and its relation to fire hazard. He took the stand that conduit should be used to the exclusion of all other methods. Luther Twichell, a prominent architect and president of the Tacoma Architectural Society was called upon by the toastmaster to respond to the toast of how the architects of Tacoma had succeeded in organizing their trust. Mr. Twichell remarked that while they had gotten together in a social way the only trust with which he knew them to be connected was getting the grocery man to trust them for their supplies, leaving the grocery man to trust in the Lord for his pay. On behalf of the architects he stated that they would be very glad to co-operate with the electrical people and would be very much interested in the bulletins they were expected to receive from the Jovian Architectural Committee. He suggested that this information be furnished in the form of bulletins on regular sized letter paper and advised the architects to provide themselves with loose leaf binders for keeping the records. He thought the architects would greatly benefit by this information as it was quite hard for them to keep in touch with an industry that was making such rapid strides.

A. I. E. E. ANNUAL CONVENTION.

The plans for the annual convention of the institute to be held at the Hotel Otesaga, Cooperstown, New York, during the week of June 23rd, are nearly completed. Manuscripts of a large number of technical papers are now in the hands of the meetings and papers committee, to be considered for presentation at the convention. The committee has accepted the following up to date, and the balance of the papers to be presented will be announced later:

"Standardization of Method for Determining and Comparing Power Cost of Steam Plant," by H. G. Stott and W. S. Gorsuch.

"The Electric Strength of Air," by J. B. Whitehead and T. T. Fitch.

"The Positive and the Negative Corona," by W. W. Strong.

"A Theory of Rupture," by F. W. Peek, Jr.

"An Oscillograph Study of Corona," by Edward Bennett.

"Test of an Artificial Aerial Telephone Line at a Frequency of 750 Cycles Per Second," by A. E. Kennelly.

"The Behavior of Synchronous Motors During Starting," by F. D. Newbury.

"The Industrial Use of Synchronous Motors on Central Station Lines," by J. C. Parker.

"Automtaic Sub-Stations," by M. R. Summerhayes.

A symposium of short papers, including the following titles, submitted by the educational committee.

Introduction, by H. H. Norris.

"New National Association of Corporation Schools," by Wm. Henderschott.

"Legislation in Vocational Education," by W. I. Slichter.

"Results Obtained by the Pennsylvania Railroad in Their New Apprentice School," by J. P. Jackson.

"A Special Feature of Vocational Work," by A. J. Rowland.

"Vocational Training in the Far West," by Wm. Sibley.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

During the period from March 24th to April 30th, the Railroad Commission rendered decisions granting the following stock and bond applications:

Los Gatos Telephone Company to issue $15,000 of stock;

Peoples Water Company to issue $1,250,000 in promissory notes and to pledge as collateral security therefor, its general mortgage 5 per cent bonds, not to exceed $3,125,000;

Stockton Terminal & Eastern Railroad Company to issue $345,000 of bonds;

Santa Rosa and Petaluma Railway Company to issue $80,000 of bonds;

Big Four Electric Railway Company to issue $400,000 of capital stock;

Pacific Electric Company to issue $6,839,000 of bonds;

Southern Pacific Company to issue $10,120,000 of bonds;

Los Angeles Gas & Electric Company to issue $900,000 of bonds;

Clara Vista Water Company to issue $30,000 of stock and $60,000 of bonds;

Sacramento Natural Gas Company to issue $193,000 of bonds;

Terra Bella Development Company to issue $15,000 of stock;

Mt. Whitney Power & Electric Company to issue $250,000 of bonds;

The railroad commission rendered a supplemental order May 5th granting authority to the Great Western Power Co. to use the proceeds from a portion of the bonds previously authorized for extensions in the Napa district, Santa Rosa district, Oakland district, Petaluma district and the island district. The amount involved is $92,672.

The commission issued a supplemental order granting authority to the Southern Counties Gas Company to issue $8000 in bonds.

The commission has denied the application of the New Freeport Telephone & Telegraph Company for permission to raise its local rates. The company operates in a territory near Sacramento. Investigation by the commission enabled the applicant to obtain modified switching arrangements with the Pacific Telephone & Telegraph Company which will serve to increase materially its revenue. With this adjustment the increase in rates was found unnecessary.

The Pacific Telephone & Telegraph Company has filed its answer denying the charges contained in the complaint filed by the city of San Jose against telephone rates in the suburban territory.

D. C. Gillen and the Pacific Gas & Electric Company have joined in the application asking that the former be given authority to sell to the latter his electric system in the city of Colusa and vicinity for $12,000.

The commission has granted authority to the Southern Sierra Power Company to proceed with the completion of its work in San Bernardino County to such extent as may be permitted by its franchise. The company has applied for a certificate of public convenience and necessity to operate under a franchise in Kern county.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

WIRING REQUIREMENTS FOR LIGHT AND POWER.

The Portland Railway, Light & Power Company of Portland, Oregon, have issued a new set of wiring instructions to contractors, architects, owners and patrons to comply with the Public Utility Act requiring companies to file copies of their rules and regulations and also have them available for public use. The following additions and changes have been made in the instructions as published in these columns October 5-19, 1912, inclusive:

All Districts.

(A) General Wiring.

(d) In all cases where meters are to be installed in cabinets, the wiring contractor must consult the company concerning the size and location of same before making the installation.

(B) Sign Wiring.

(c) All signs wired for 110-120 volt lamps having more than 66 receptacles or requiring more than 1320 watts, must be wired for a 3-wire service with load balanced.

(d) All signs wired for 110-120 volt lamps having 66 receptacles or less, or requiring 1320 watts or less must be wired for a 2-wire service.

(f) The wiring for all series multiple signs must be arranged for connection to a 2-wire, 120 volt feeder-circuit when the number of lamps in the sign is between one hundred (100) and two hundred and sixty (260), and for connection to a 3-wire 120-240 volt feeder-circuit when the number of lamps is two hundred and sixty (260) or over.

(Signs of less than one hundred (100) lamps must not be wired on the series multiple system.)

(g) The regular multiple signs in the overhead district that are to be equipped with 12 volt Mazda sign lamps, must be supplied with and connected to a 120 volt to 12 volt transformer, when the load is 1320 watts or less, and to a 240 volt to 12 volt transformer when the load is more than 1320 watts.

(D) Lamps.

(d) Free lamp renewals are furnished in the following sizes only: 4 and 8 c.p. carbons and 50 and 80 watt gems.

Underground District.

(B) Wiring.

(e) Customers' switches must not be installed on the company's meter board, and customers' conduit should terminate at a point, so that when equipped with the proper condulet, the condulet will be at least six (6) inches from the meter casing.

Overhead District.

(B) Wiring.

(a) All service feed wires, etc. This paragraph applies to the City of Portland, St. Johns, Lents, Oregon City and Salem.

(h) The company will furnish and install the switchbox at its own expense and in all cases sufficient space must be left on the meter board for the installation of the above mentioned switch box.

The company prefers, however, that the wiring contractor furnish and install this switch box for them, providing satisfactory arrangements can be made before the installation has been started.

(i) The company will install a recording watt-hour meter upon all services, and the necessary wiring must be provided by the customer in all cases.

All meter loops of No. 8 wire or larger must be made of flexible wire. This applies to all districts.

NEWS OF THE ELECTRICAL CONTRACTORS.

The Wm. A. Mullins Electric Company, 1014 A street, Tacoma, recently secured the contract for installing a complete telephone system, fixtures and wiring—some 200 outlets complete, in the 40-room Admiralty hotel at Port Ludlow, Washington.

Davis & Hull, electrical engineers and contractors, 942 Commerce street, Tacoma, have secured the contract for motor installation in the new four-story furniture factory of F. S. Harmon & Company, for which they had previously prepared plans and specifications. The equipment throughout will be 3-phase, 220 volts, Westinghouse motors. The installation will be conduit and the most modern and up-to-date materials and methods will be used.

C. A. Young, manager Electric Construction Company, 937 Commerce street, Tacoma, reports that his company is wiring two large residences in the north end of town, also one at American Lake and another at Spanaway Lake.

Buxbaum & Cooley, electrical contractors, 68 Columbia street, Seattle, have just completed the installation of an electric light plant on the Tug Printer. They are also getting up a design for a customer in the nature of an engine room telegraph and alarm system which will indicate electrically whether or not an order given from the pilot house to the engine room has been carried out.

R. Cheadle, manager of the Union Electric Company, 93 Columbia street, Seattle, announces that the company has just completed wiring an immense sign for the Albers Brothers Milling Company on the tide flats.

TRADE NOTES.

The Puget Sound Traction, Light & Power Company, Seattle, has bought 25 single end cars; maximum traction truck, Westinghouse motors.

Kilbourne & Clark Manufacturing Company, 71 West Columbia street, Seattle, is installing a completely equipped electrical testing laboratory.

Evans-Dickson Company, consulting and contracting electrical engineers, Tacoma, have been selected by the town council of Etonville, Washington, to report on the most suitable water-power location and to prepare estimates of the cost of developing power to be used in lighting the business and residence sections, also for street lighting. The requirements will be 100 kw. The town has no provisions at present for lighting except private gasoline plants.

The Westinghouse Electric & Manufacturing Company have secured a contract from the Portland Railway, Light & Power Company for the following equipment for the Bull Run station of the company: 1-500 kw., 3-phase, 60-cycle, 6600-volt, 720 r.p.m., synchronous, self-starting motor generator set; 1-500 kw., d.c., 600-volt, flat compound wound, interpole type, railway generator; 1-250-volt direct connected exciter set. This apparatus to be used in connection with the electrification of the Mt. Hood Railway Line.

The Allis-Chalmers Company have sold the Douglas County Light & Water Company, Portland, Oregon, a single runner, vertical turbine, setting in an open flume. The complete description of the apparatus furnished is as follows: 1-560 b.h.p., 90 r.p.m., single shaft, hydraulic turbine, operating under a normal effective head of 13 ft.; 1 oil lubricating thrust bearing to carry rotating weight of turbine and generator rotor; 1 oil pressure governor; 1 alternating current revealing field generator, single bearing, vertical water wheel type.

INDUSTRIAL

IMPROVED HORN GAPS FOR ALUMINUM LIGHTNING ARRESTER.

The horn gaps for aluminum lightning arresters shown in the illustrations have been greatly improved by the addition of charging resistances. The discharge paths to the cells consist of a main gap and an auxiliary gap, with a low series resistance in parallel with the main gap.

The auxiliary gap has a smaller setting than the main gap and is fitted with a short-circuiting contact which at times of charging, bridges the auxiliary gap and charges the cells through the resistances.

In the normal operation of the arrester this arrangement of horns introduces selective paths for the discharge of lightning or other forms of potential surges. One path consists of a small auxiliary gap, a low resistance and the aluminum cells. The other path consists of only the main gap and the aluminum cells. All discharges will first spark across the auxiliary gap and pass to ground through the resistance and the cells. If, however, the quantity of discharge is too great to be dissipated through this path, the discharge automatically shunts to the main gap, where it is not impeded by the resistances. The resistance is of low value and consequently all but the heaviest discharges are taken care of by this auxiliary path.

15,000-Volt Lightning Arrester for Three-Phase Non-Grounded Neutral Circuit.

It is well known that any arc on a high-voltage circuit, especially if it alters the electrostatic condition of the circuit, is accomplished by oscillations. An example of this is noted when an arc takes place over a line insulator or from a transmission line to an adjacent tree. The resulting oscillations may be harmless or may result in local high potentials as a result of resonance. The same phenomenon in a very mild form has been noticed at times of charging aluminum arresters.

By the addition of charging resistances and short-circuiting contacts for the horn gaps, all possibility of troubles due to the charging of arresters is greatly minimized if not entirely eliminated.

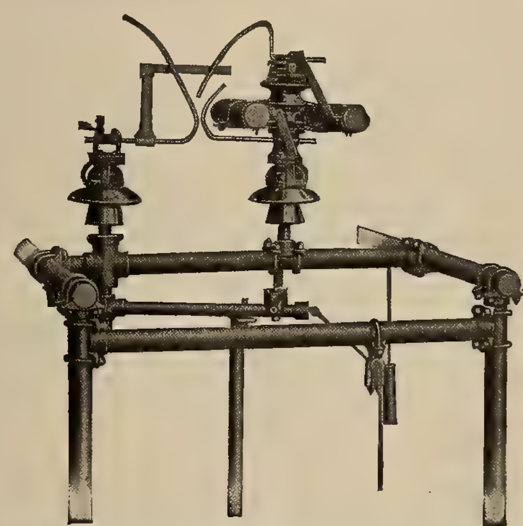
The advantage to be gained by the charging resistances and short-circuiting contacts are as follows:

1. Arresters with charging resistances have selective paths for discharges. These paths are so arranged that all but the most severe disturbances are discharged through the resistance. In case of a discharge across the main gap, the arc will be intercepted by the auxiliary horn, which is located directly above, and hence be broken through the resistance.

2. The charging is always performed through a resistance which limits the initial rush of charging current when the cells have been standing for twenty-four hours or more.

3. The short-circuiting contacts make direct contact at the auxiliary horn when charging, thereby eliminating the arcing except at the instants of making and breaking the contact.

4. The elimination of the arcing except at making and breaking contact, and the introduction of the resistance in this path modifies the current wave and actually reduces the value of the charging current.



15,000-Volt Horn Gap, showing short circuiting contact and charging resistance with auxiliary gap short circuited for charging.

5. The greater uniformity of the charging current mentioned in items 2 and 4, results in longer life to the electrolyte and cones. The charging resistances are safety devices for any poor conditions of the arrester cells.

6. The elmination of oscillations caused by the charging arcs.

7. New installations of arresters, and arresters which have remained uncharged for several days, can be put into service by charging at full potential, if they are equipped with charging resistances. Operators should, however, not rely on this additional safety device, as the most satisfactory results can be obtained only by regularly performing the charging operation.

8. The short-circuiting contacts permit the gaps to be set with the horns in the same vertical plane instead of having to offset one horn, as previously. This insures more uniform and permanent gaps, as lost motion in the mechanism has practically no effect on the gap setting.

9. Charging resistances do not sacrifice any of the valuable features of an arrester, and by their addition the arrester is made more sensitive, reliable and durable.

The horn gaps described above are manufactured by the General Electric.

PICNIC FOR GENERAL ELECTRIC CO. AND PACIFIC STATES ELECTRIC CO. EMPLOYEES.

The employes and families of the General Electric Company and Pacific States Electric Company have been invited to attend a basket picnic at Glendale Park, Niles Canyon, California, on Saturday, May 17th, as the guests of the companies. The offices, shops and store-rooms of both companies will be closed the entire day, and a special train will be engaged to take 550 or more to the grounds where every facility will be provided for a good time.

LITTLE DAMAGE TO SUBMERGED MOTOR CONTROL EQUIPMENT.

At the time of the recent disastrous flood in Ohio there were fifteen multi-voltage calendar controllers, three alternating current motor control panels, two 500 h.p. multiple switch motor starters and many miscellaneous types of Cutler-Hammer controllers in the plant of the Goodyear Tire & Rubber Company, Akron. All of this equipment was completely submerged for a considerable period. Water and mud, the latter particularly had gotten into every crevice, some of the drum controllers being found filled with mud. Upon testing the calendar panels there was apparently a considerable ground but this proved to be due to the moisture in the grid resistance insulation which was quickly dried out with blow torches and the panels ready for use as soon as the calendars were ready to be driven. The Varley coils with the exception of three which were damaged in the handling. were entirely unaffected by the long submersion in water. The cement covered resistance units also, with the exception of two broken in conveying to dry rooms, were not affected by the water. The entire equipment was put back in operation as soon as the machinery of the plant was ready and no trouble was experienced.

ELECTRIC SCORE BOARD, PORTLAND, OREGON.

One of the most unique adaptations of electricity to our every day necessity—that is at certain times of the year—is the new baseball score board of the Evening Telegram, of Portland, Oregon.

In the middle of an ordinary black metal sign structure is painted a white diagram of a baseball diamond, and every position of the players is designated by a red light. The red lights on the bases of the diagram are duplicated with white lights by which men on bases are represented.

Across the top of the structure three rows of lights are so arranged that white lights announce the innings and the score of both contending teams.

On the sides of the structure are shown the "line up" of the teams, this being painted on each day or when the "line up" is changed. The lighting of all the white lights opposite a team indicate the team is "at bat." By putting the light out opposite a name indicates that particular player is "at the bat."

If the man "at the bat" smacks a fly to center field the center field red light will light, if he catches it, another light over the painted words "Out" also is lit.

Besides indicating plays as above described, the following also can be indicated:

"Out (Stealing)," "Stolen (Base)," "Out," "Double Play," "Foul," "Safe (Error)," "Sacrifice." "Strikes," one two and three. "Balls," one, two, three and four.

On the top of the structure there is mounted a bell to announce the beginning and end of a game. All of this mechanism is operated from a table inside of the paper's office as the reports are received over the telephone and telegraph wires. This sign was constructed by the Telegram's electrician.

CABINETS MANUFACTURED IN OREGON.

The Oregon Welding & Manufacturing Company of 305 Glisair street, Portland, are manufacturing a complete line of approved iron cabinets. The boxes are made of a single sheet of metal forming the bottom and the side walls. The edges of the side walls are bolted together at the corners and the joint is welded by the oxyc-acetylene process.

The Western Electric Works of 213 Sixth street, Portland, Oregon, also mnaufacture a line of approved cabinets. In addition to cabinets they are equipped to build labeled panel-boards. The Portland Board of Education, Fourteenth and Morrison streets, build approved cabinets and tablet-boards for their own use, also the Portland Railway, Light & Power Company have made application for labels for approved cabinets—knife switches. The Portland Railway, Light & Power Company are manufacturing for their own use.

BOOK REVIEW

Bells, Indicators, Telephones, Fire and Burglar Alarms, etc. By J. B. Redfern and J. Savin. Size: 4½ x 6½ in.; 123 pages; 85 illustrations; cloth binding. Published by D. Van Nostrand Company, of New York and for sale at The Technical Book Shop, 106 Rialto Bldg., San Francisco, Cal. Price, 50c.

This is another one of the installation manuals which have been making their appearance from time to time by this publishing house. The matter set forth within its pages describes in a clear, lucid, simple manner the practical points necessary to observe in installation of all types of bells. The book is indeed useful to all having anything to do with the practical installation of such types of apparatus.

NEW CATALOGUES.

Catalogue No. 11 from the Line Material Company of South Milwaukee, Wis., describes and lists a complete stock of materials for line installations, including fixtures, brackets, posts, pins and hangers.

Conduit Catalogue No. 439, just issued by the Sprague Electric Works of the General Electric Company, is an illustrated work covering almost the entire field of conduit products in its 100 pages. This includes Greenfielduct, an attractive and complete list of boxes and covers, including new adjustable and non-adjustable gang floor boxes, Greenfield flexible steel conduit, flexible steel armored conductors, BX cable and armored cord. Considerable convenience will be found in the carefully compiled tables and information relative to the adaptability of "Fittings" to other manufacturers to Sprague boxes and covers.

The General Electric Company has issued Bulletin No. A4116 describing Isolated and Small Plant Alternating Current Switchboard Panels, both generator and feeder, for three-phase, 25 to 60-cycle circuit. The bulletin is made up principally of dimension and connection diagrams, and miscellaneous data referring to the various panels and equipments. Bulletin No. A4119 is devoted to the application of electricity to the operation of packing establishments. In the bulletin are illustrated various applications of the electric motor. No. A4084 is devoted to "Centrifugal Compressors." Bulletin No. A4113, entitled "Oil Switches for Small Capacity Industrial Application," illustrates and describes Type F, Forms P3 and P6. No. A4102, devoted to "Sewing Machine Motors for Family Size Machines," contains illustrations and descriptions of the new design of motor perfected by the company. "Cloth Pinions" is the subject of No. A4110, containing data relative to tooth dimensions and instructions for the selection of pinions. Bulletin A4061 is devoted to "Electric Arc Headlights." The foregoing suspersede previous bulletins on their respective subjects. Bulletin A4097 describes in considerable detail ventilated motors for railway service.

NEWS NOTES

INCORPORATIONS.

ANACORTES, WASH.—The Anacortes Light & Water Company, have filed articles of incorporation to engage in water, lighting and general wiring and merchandise business.

AURORA, ORE.—The Aurora Mutual Telephone Company has been organized. Geo. A. Ehlen, president; Geo. X. Goding, vice-president; Adam J. Mishler, secretary; Chas. A. Becke Jr., treasurer.

ANAHEIM, CAL.—Articles of incorporation have been filed by the La Habra Domestic Water Company, organized by residents of La Habra valley. The capital stock is $20,000. The incorporators are: W. L. York, C. J. Hinshaw, J. G. Launer, C. M. Glazier, J. C. Knight, K. G. Sargent, J. L. Morris, C. L. Brewster, C. A. Ridgway, W. H. Redfern, W. A. Davis, F. A. Hersey, La Habra Citrus Association, G. W. Beck and C. E. Sutton.

LOS ANGELES, CAL.—With paid-in capital of $1,000,000 and bond issue of another $1,000,000, the Sentinel Heights Water Company, has just been incorporated for the primary purpose of supplying big southwest section holdings of the Los Angeles Investment Company, with water, also for the purpose of supplying water to territory between western city limits of Los Angeles and Santa Monica and Venice and south as far as Inglewood. The officers of the company are: Chas. A. Elder, president; Earl B. Elder, vice-president; W. D. Deeble, Secretary, and C. L. Mowder, chief engineer and general manager.

ILLUMINATION.

MEDFORD, ORE.—W. J. Hills and Dr. E. H. French are behind plans for a gas plant here.

SAN DIEGO, CAL.—The tall electric light towers which dot San Diego will soon be removed and replaced by street arc lights.

ALBANY, ORE.—G. L. Rauch and J. D. Welch of Portland, have applied to the city council here for a franchise to install a gas plant.

VANCOUVER, B. C.—The Bowness Investment Company of Calgary, will receive tenders until 5 p. m., May 31, for power machinery and equipment.

CENTRALIA, WASH.—The county commissioners have granted a franchise to the Independent Electric Company to erect light and power lines from Winlock to Toledo.

LOS ANGELES, CAL.—The Southern California Gas Company has applied to the board of supervisors for permission to transfer the franchise of the Midway Gas Company to its own name.

EATONVILLE, WASH.—The Evans-Dickson Company, 725 Commerce street, Tacoma, has been commissioned by the town to pick a power site on Mashell River. It is planned to develop 150 horsepower.

LAS VEGAS, CAL.—A million dollars is to be invested in a power plant project destined to supply electric light and power to Las Vegas and adjoining valleys. The enterprise is backed by Ira McFarland.

LOS ANGELES, CAL.—Bids will be received up to May 19th, by the board of supervisors of Los Angeles county, for furnishing the necessary equipment for lighting with electric lights certain streets in Bairdstown lighting district.

REDLANDS, CAL.—The ornamental light system which is now being installed in the business section of the city will be enlarged. It has been decided to place lights on Fifth street, from Central avenue to Vine street, which were not included in the original contract.

DAWSON, YUKON, TERRITORY.—The power house of the Dawson Electric Light & Power Company was burned to the ground May 4th, with a loss of $200,000. Temporary electric service was established by making connections with the North Fork Hydroelectric plant.

PRINEVILLE, ORE.—The hydroelectric power plant of the Des Chutes Power Company, on Crooked River, Oregon, has been completed. The site is at a point on this stream one mile above where it empties into the Des Chutes. The one unit now ready for work has a Leffel water wheel, direct connected to generator. Transmission lines have been extended 40 miles to serve Prineville, Redmond, Culver, Madras and Metolius. L. N. Simpson, Prineville, is general manager for the company.

PORTLAND, ORE.—The Northwestern Electric company's plant on the Salmon River has been completed and by May 15th will be prepared to deliver 4000 horsepower to the Camas paper mills. For the present the company will operate only one of its two turbines. When the Portland distributing system is ready, both turbines will be used. Together they will generate about 20,000 horspower. Work on the pole line between Camas and Portland is now being rushed. It is expected that delivery in Portland will be made about September 1.

ROSEBURG, ORE.—The Douglas County Light & Water Company is building a new hydroelectric power plant on the Umpqua River at Winchester, to supplement the plant it has now in operation. The contract to furnish and install the equipment has been let to Allis-Chalmers Company, through its Portland office. The machinery is to consist of a 700 horsepower vertical, open-flume turbine, to be operated under 14 ft. head, and direct connected to a 500 k.v.a., 6600-volt, three-phase, sixty-cycle, water-wheel type, vertical alternator at ninety r.p.m.; also including all governing mechanism and exciting generator.

TRANSMISSION.

RENO, NEV.—The Elko-Lamoille Power Company, which was granted a franchise to operate in Elko county by the last legislature, has purchased the electric plant of the Elko Power & Water Company, from W. T. Smith of Elko and his associates.

PORT ANGELES, WASH.—Bids will be taken soon for the construction of the Elwha dam of the Olympic Power Company. The estimated cost is $500,000. The engineer in charge is Prof. Daniel W. Meade, professor of engineering, University of Wisconsin.

TAFT, CAL.—The San Joaquin Light & Power Company is preparing to double the capacity of the present big system at both the Midway and McKittrick substations. Two years ago in July the company started operations in the Midway field with one 150 h.p. generator and a gas engine. The small generator was soon thrown out and the substations installed. In the Midway and McKittrick fields at the present time there are in the neighborhood of 325 motors drawing power from the substation.

TRANSPORTATION.

SALEM, ORE.—The State Railroad Commission has ordered the Corvallis & Eastern to rebuild practically its entire railroad of 140 miles.

ABERDEEN, WASH.—The Grays Harbor Railway & Light Company will spend from $15,000 to $20,000 in changing of trackage and other improvements.

PORTLAND, ORE.—The Oregon Electric, Joseph H. Young, president, is considering tunneling of the hills west of the Willamette River. The project would cost $500,000.

SAN JOSE, CAL.—Franchises for portions of the electric railroads in this city formerly operated under county franchises have been granted the San Jose Railroads by the city.

SEATTLE, WASH.—The council has granted a franchise to the Seattle & Montana Railway to lay tracks and operate the same along and across certain streets and avenues in this city.

LEWISTON, IDAHO.—Lewiston-Clarkston Valley Railway Company, F. L. Sturm, president, have awarded a contract to the General Electric Company, through W. C. Campbell, Portland, for electrical appliances.

GLENDALE, CAL.—Application has been made to the city council by Pacific Electric Railway Company for a franchise for 50 years, from Everett to Glendale avenue on Broadway, and right to cross Fifth, Sixth and Ninth streets. This is the initial steps on the part of the company toward extending the line through the eastern section of the city.

ANAHEIM, CAL.—The supervisors have a request from the Pacific Electric Company for permission to make fills at a number of street crossings between Santa Ana and Stanton. The communication states that the company is anxious to complete double-tracking between these points, and asks that the resolution be passed as soon as possible, in order to take the matter up with the railroad commission and begin work.

LOS ANGELES, CAL.—With the Pacific Electric application to the city council for a 40-year franchise for a four-track elevated railroad from the present Main street terminal east to San Pedro street, at an estimated cost of $600,000, the first step was taken in a plan which contemplates the entire elimination of grade crossings within a good part of the city. The elevated way will commence at San Pedro street, two tracks wide, and extend to an overhead crossing at San Julian street, where the two tracks will be increased to four, extending thence to the main station, crossing Wall street, Maple avenue and Los Angeles street. The present elevated structure over Los Angeles street will be incorporated in the new elevated but the deck will be widened to accommodate four tracks while the passage entrance into the station will be correspondingly enlarged.

SAN FRANCISCO, CAL.—The supervisors have passed to print a declaratory ordinance announcing its purpose to provide for such extensions of the existing municipal railway system as shall give lines to the exposition grounds, the Presidio and intervening points from the waterfront and from Market street via the present Union street line, Stockton street, Van Ness avenue and connections; also a road to and upon Potrero avenue to Twenty-fifth street; another out Market street to Church street and along the latter to a terminus at Thirtieth, and still another on California street from First avenue to Thirty-third. The estimated cost of the proposed acquisition of the railway lines in question is $3,500,000, which is to be provided by a bond issue. The board also adopted a resolution formally soliciting offers for the sale to the city of lines such as those desired to be acquired, the charter providing that before public utilities may be created by the city by original construction proposals for the sale of such as may be already in existence under private ownership shall be invited. A proposition may be received from the Presidio & Ferries Railway Company, whose franchise lapses next December, to turn over its equipment and other property for the city's use, since the so-called Union street line, extending from the ferries via Washington and Jackson streets, to Montgomery, and thence along Columbus avenue and Union and other streets to the Presidio, has been counted in as an integral and important part. The addition of the line on California street from First avenue westward is made possible by the fact that the United Railroads' franchise over almost this entire stretch of street has lapsed, though the cars are still running by informal agreement on the part of the city.

TELEPHONE AND TELEGRAPH.

CARSON CITY, NEV.—The local telephone company is making a number of changes in its lines in this city. The number of phones on party lines will be reduced.

SUSANVILLE, CAL.—A merger has been completed of the California Northern Telephone & Telegraph Company and the California & Oregon Telephone Company. This includes the acquirement by lease of the lines of the Nevada-California-Oregon Telephone Company, which operates between Reno and Lakeview, Ore. The deal was engineered by Hills, Hendricks and Mathews of the California Northern Telephone & Telegraph Company, and has been pending for some time. The California & Oregon Telephone Company will now branch out and construct standard telephone toll lines and exchanges, as well as operate the telegraph business in the northern country. The toll lines and exchanges will be operated in connection with the leased line of the Nevada-California-Oregon Company, known as the Dunaway line, which has heretofore been controlled by the Wingfield interests. The largest exchange will immediately be built at Alturas. Under the rearrangement of wires contemplated the California & Oregon Telephone Company will operate all telephone and telegraph business north of Doyle, with a telegraph and telephone outlet to Reno, and the California Northern Telephone & Telegraph Company will operate all the telephone business in this locality, as heretofore. A direct circuit will be provided between Susanville and Reno. The California Northern Company will also operate the Susanville office of the W. U. Telegraph Company as soon as that corporation builds its line into Susanville along the line of the Fernley-Lassen branch of the Southern Pacific road. The head offices of both companies will be in Susanville, and W. E. Hills, vice-president and general manager of the California Northern Telephone & Telegraph Company will be in charge.

WATERWORKS.

LACONNER, WASH.—The city council has determined to buy the waterworks system of J. O. Festerf if the price is made satisfactory. The price originally asked was $9500.

LIVINGSTON, MONT.—The election on the issuing of bonds in the sum of $225,000 for a waterworks system, carried by a large majority. The money will be used either to purchase the present plant or to build a new one.

LODGE, MONT.—The election to bond the city in an additional sum of $30,000 for the purpose of laying larger water mains (12 inch) from the head gate of the present system to increase the city supply, carried by a vote of 121 to 19. The date for the sale of the bonds has been fixed for May 29.

RIVERSIDE, CAL.—In order that no possible technical objections may stand in the way of the sale of proposed issue of $1,160,000 water works bonds, the city council has authorized Mayor Peters to engage the firm of Dillon, Thompson & Clay, attorneys of New York, for an opinion on the validity of the proceedings.

LOS ANGELES, CAL.—A private water system near Colton has been purchased by the Clara Vista Water Company, and it is understood that the new owners will make improvements and extensions. To carry out the plans the Clara Vista Company will issue bonds in the sum of $60,000 and $30,000 in stock.

SANTA MONICA, CAL.—Many test holes are being sunk by Messrs. Quinton and Code, hydraulic engineers, of Los Angeles, in making examination of the distributing systems of the four water companies supplying consumers here. The purpose is to furnish an estimate of the value of local plants as a basis for calculation of the cost of the municipal water plant, including the cost of taking over such of the local plants as may prove serviceable.

PROFESSIONAL DIRECTORY

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE—Two steel tanks, 6 ft. by 12 ft., with convex heads; sheets ½ in. and heads ⅜ in. These tanks are new and only partially built. A bargain. San Francisco Disposal Co., Evans and Keith Streets, San Francisco.

WHERE TO BUY IT IN THE WEST

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Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Manhattan Elec. Supply Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.
Manhattan Elec. Supply Co.

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American Ever-Ready Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Edison Storage Battery Supply Co.
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Manhattan Elec. Supply Co.
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Manhattan Elec. Supply Co.
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Pass & Seymour, Inc.
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Converters
Wagner Electric Mfg. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Oil
Fairbanks, Morse & Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

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Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. Co.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Economy Electric Co.
San Francisco, 444 Market

Edison Storage Battery Supply Co.
San Francisco, 818 Mission.

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
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Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

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San Francisco, 807 Mission.
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holophane Works of G. E. Co.
San Francisco, Aranson Bldg., 3rd and Mission Sts.

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Pacific States Electric Co.
Pass & Seymour, Inc.
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Western Electric Company
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Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

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Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
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General Electric Company

Governors, Water-Wheel
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Ohio Brass Company
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Pierson-Roeding Company
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General Electric Company
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"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
Pass & Seymour, Inc.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
Pass & Seymour, Inc.
Pierson, Roeding & Co.
"Pittsburg," Elec. Agen. Co.
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Ohio Brass Company

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Ohio Brass Company
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Electric Appliance Co.
General Electric Co.
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Packard Lamp Works.
Pacific States Electric Co.
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Western Electric Co.
Westinghouse E. & M. Co.

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Electric Appliance Co.
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Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

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"Dayton," Elec. Agencies Co.

Lightning Arresters
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Westinghouse E. & M. Co.

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Westinghouse E. & M. Co.

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Magnets, Lifting
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Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis, R. R. Poppleton, W. M. Price Co., A. T. Egan.
Fairbanks, Morse & Co.
General Electric Co.
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
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General Electric Co.
Westinghouse Elec. & Mfg. Co.

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Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

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Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

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McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

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Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Mannesmannrohren-Werke
Pittsburg Piping & Equip. Co

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Manhattan Elec. Supply Co.
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Plugs, Stage
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Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Boiler Feed
Fairbanks, Morse & Co.

Pumps, Centrifugal
Byron Jackson Iron Works.
Fairbanks, Morse & Co.

Pumps, Deep Well
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Vacuum
Simonds Machinery Co.

Push Buttons
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company

Rail Bonds
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Johns-Manville Co., H. W.
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Wagner Electric Mfg. Co.
Westinghouse E. & M. Co.

Reflectors
Holophane Works of G. E. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 807 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Manhattan Elec. Supply Co.
San Francisco, 403 Atlas Bldg., 604 Mission St.

Mannesmannrohren-Werke
San Francisco, Rialto Bldg.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Nason & Co., R. N.
San Francisco, 151 Potrero Ave.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Ohio Brass Co.
San Francisco, 523 Mission.
Los Angeles, 372 Pac. Elec. Bldg.
Seattle, 524 First Ave. So.

Okonite Co.
All Jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pass & Seymour
San Francisco, Rialto Bldg.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

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San Francisco, Monadnock Bldg

Poppleton, R. R.
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Post Co., The Frederick
San Francisco, 135 Second

Price Co., W. Montelius
Seattle, Wash.

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer.
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg.

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Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
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Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
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Switches, High Tension
Bowie Switch Co., The
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Manhattan Elec. Supply Co.
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Tape.
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Okonite Company, The
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Fairbanks, Morse & Co.
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Wire, Aluminum.
Pierson, Roeding & Company
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Standard Und. Cable Co.
Western Electric Company
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General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
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National Con. & Cable Co., The
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Van Emon Elevator Co.
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Wagner Electric Mfg. Co.
San Francisco, Rialto Bldg.
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San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758W.Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 527 So. Main
Seattle, Central Bldg.
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Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
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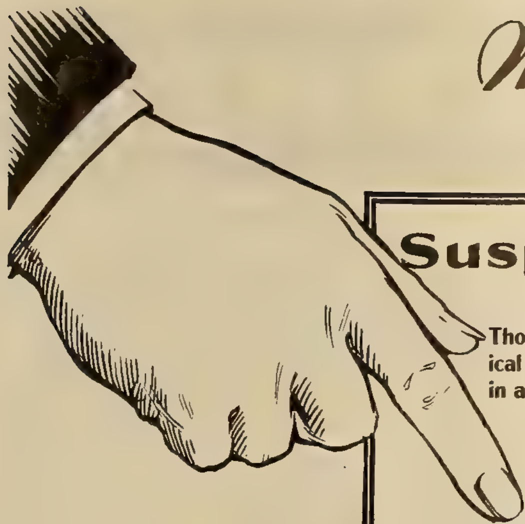
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 PacificBlg.
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco, 682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

With his finger on this ad.



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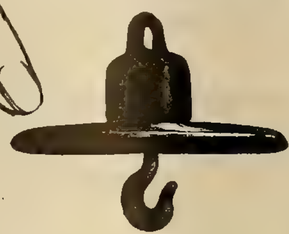
"Thomas Quality"

Thomas Suspension Type Insulators are of uniform electrical and mechanical characteristics. Each insulator is carefully inspected and tried out in a modern testing plant. A most popular type is



Insulator No. 1053

Voltage Data

Volts Dry Test	Volts Rain Test	Leakage Distance	Arcing Distance
70000	48000	10 in.	4¾ in.

These Units are recommended for Voltages as follows

Line Voltage	44000—	2 units
" "	66000	3 "
" "	88000	4 "
" "	110000	6 "

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JOURNAL OF ELECTRICITY

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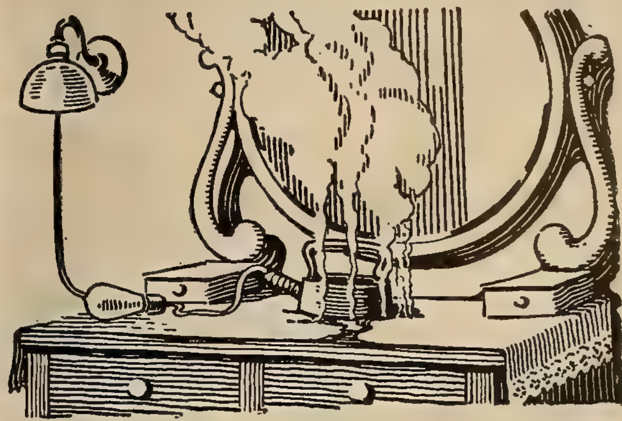

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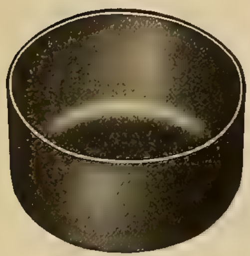
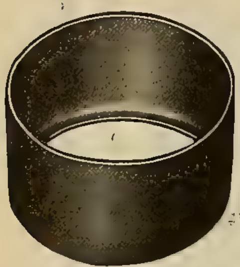
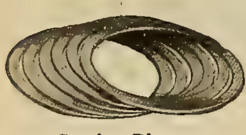
Punched Disc


Cupped and Trimmed.


Blank Punched Out of Bottom.


Spacing Rings.


Assembled Field Punchings for A. C. Motors.

The illustrations show the principal steps in the construction of the "Drawn Shell" motor manufactured by the General Electric Company.

To all who possess a quick discernment for real values in goods electrical, "Drawn Shell" construction has many interesting features which become readily apparent from a close inspection of the product.

Uniformity of excellence in the material used for Drawn Shell motors is obtained through purchase in large quantities under rigid specifications. As the combined result of unequalled tool equipment, scientific manufacturing processes, the employment of expert workmen, and final testing under the supervision of the Designing Engineers, a practically flawless finished product is assured.

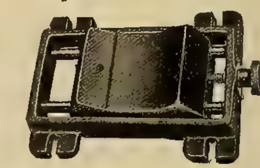
The satisfactory continuous operation at brake horsepower rating of all Drawn Shell Motors, with ample margin for reasonable overloads without sparking or overheating, is made certain by a careful, initial design and those niceties in mechanical and electrical construction, characteristic of all material bearing the trade mark "G-E".

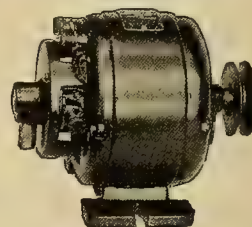
Drawn Shell Motors are used to drive small machine tools, pumps, compressors, vacuum cleaners, sewing and washing machines, etc., etc.—these sturdy little motors meet an infinity of power purposes for shop, factory, store, office or home.

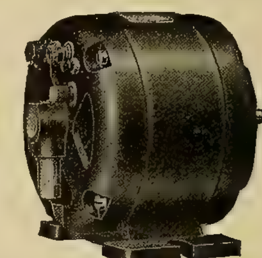
Sizes 1/50 to 3/4 H.P.—with open or totally enclosed frames.

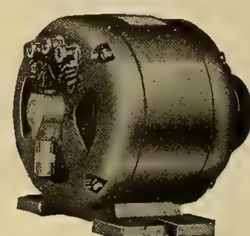
Bulletin No. 4963 giving a complete description of Drawn Shell Motors will be gladly sent on request to the nearest office of the General Electric Company.


Rings and Punching Clamped by Forcing Over Edges of Cup.


Sliding or Plain Removable Base Furnished as Desired.


Type DSD Direct Current Motor


Type DSS Single-Phase Alternating-Current Motor.


Type DST Three-Phase Alternating-Current Motor.

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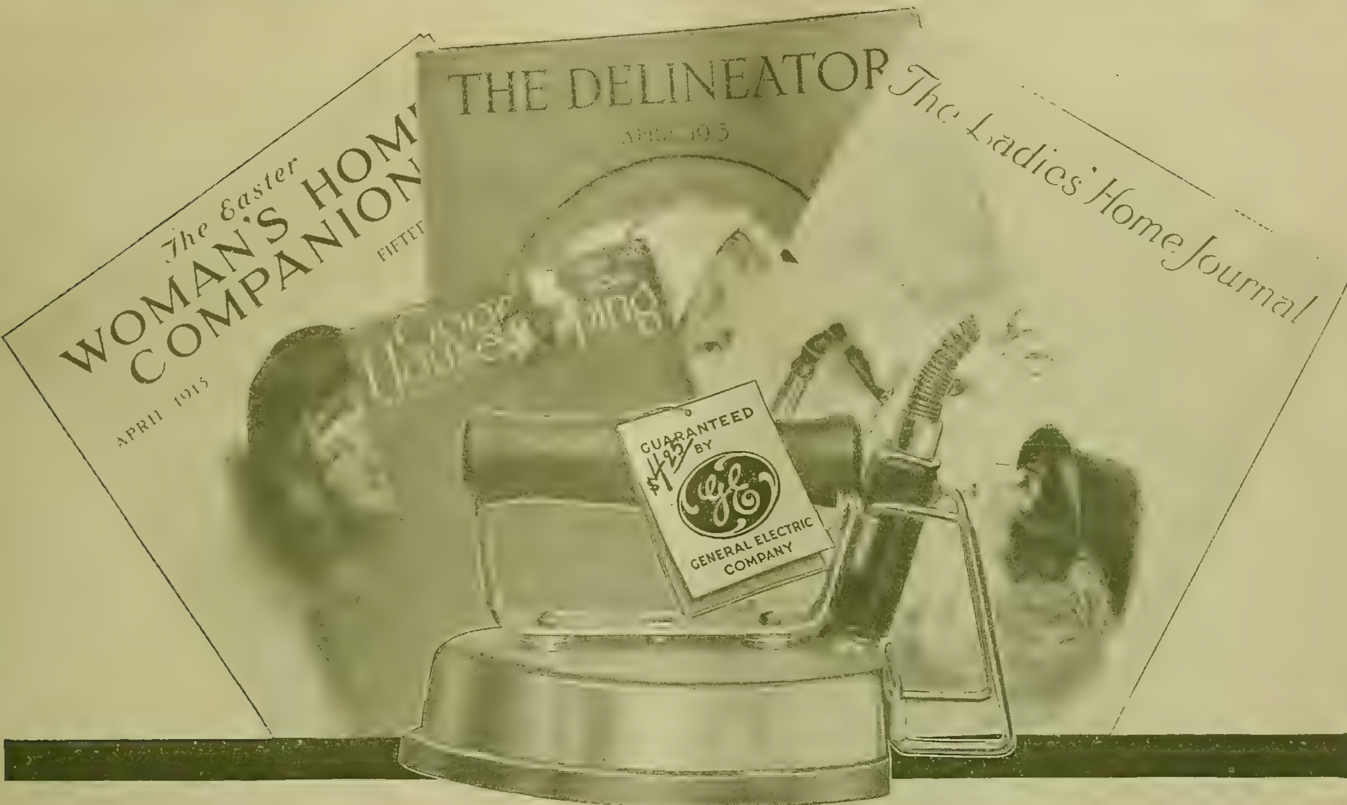

Continuous Advertising for Continuous Sales

G-E Flatirons will be advertised continuously throughout the summer season.

In these nationally-read women's magazines, G-E Flatirons will be advertised during May, June and July to nearly four million subscribers and probably two or three times that number of readers.

Additional advertising in the Saturday Evening Post, Literary Digest and other magazines, will reach other millions of possible users of G-E Flatirons at the beginning of the season.

All this country-wide publicity will feature the G-E Calorite leaf heating unit design—the standard for four years.

This advertising is bound to create an ever-increasing desire for electric flatirons among those women who do not already possess one.

Local advertising can turn this *desire* into *sales* of more G-E Flatirons.

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Largest Electrical Manufacturer in the World

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Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Shoshone Falls, on the Snake River, Idaho.

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Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages, 9, 10.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX | SAN FRANCISCO, MAY 17, 1913 | NUMBER 20

WATER POWER RESOURCES OF SOUTHERN IDAHO

BY E. A. WILCOX.

The advancement made in the practical application and use of electric power during the past one or two decades has revolutionized the industrial and civic welfare of the world to such an extent that the opportunities and capacities for development of electric energy is today deemed one of the most valuable natural resources of any locality. It is, therefore, natural that the great power sites of Southern Idaho are considered as one of its greatest assets, and its rapid development and growth can be attributed in a large way to this great natural advantage.

The general relief of Idaho with its high snow-capped mountain ranges and its extensive valleys and plains, provides watersheds to furnish wonderful, never-failing water supply for the creation of large rivers and streams. The natural fall of these streams is such that unlimited power may be harnessed and put to practical every day use.

Perhaps the most remarkable opportunities for power development are found on the Snake River in the central portion of its semi-circular course across Southern Idaho, in and through the great Twin Falls country where immense irrigation tracts have so recently been developed by the Kuhn interests of Pittsburg and other enterprising capitalists.

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Twin Fall of Snake River, Idaho.

Between American Falls in Power County and Glenns Ferry in Elmore County, a distance of but two hundred miles, the river drops many hundreds of feet. The fall is not a gradual one, but rather consists of a succession of abrupt changes in elevation of the river bed, whereby natural head developments are made feasible and practical. On account of the moderate climate and the many springs that flow into Snake River in this vicinity, ice never forms in the stream and trouble from this or similar sources is unknown even during the most severe winter seasons.

At American Falls, the Southern Idaho Water Power Company, a Kuhn enterprise, is now developing approximately 6500 horsepower, and an eventual development of 40,000 horsepower has been mapped out. The head at the site is about 50 ft. Energy from this plant is at present transmitted over a line some 60 miles in length, and is being supplied to Pocatello, American Falls, Ross Fork and Blackfoot.

At Minidoka, the United States Reclamation Service has completed a plant having an aggregate capacity of 7500 horsepower, which is being utilized mainly for the operation of irrigation pumping plants and for lighting, heating and power purposes on the government projects.

Exterior Twin Falls North Side Plant No. 2.

At Twin Falls on the Snake River, a direct head of 150 ft. is available, and a modern development of 10,000 horsepower is contemplated. When completed, this will be one of the best and most attractive power installations in Southern Idaho, and will form a part of the Great Shoshone and Twin Falls Water Power Company's present system.

The Kuhn interests have constructed a large power plant at Shoshone Falls of 2000 horsepower capacity, which is now being increased to 7500 horsepower, the necessary provisions in the hydraulic installation having been made for an ultimate development of 15,000 horsepower. It is a natural head plant, and makes use of a 200 ft. fall in the river.

The Auger Falls site, located a few miles below Shoshone Falls, makes a drop of 125 ft., and is capable of furnishing 10,000 horsepower without in any way augmenting the stream flow.

A power plant designed to harness 8000 horsepower has been constructed at Thousand Springs where several hundred second feet of water empties into the Snake River from an elevation of 175 ft. A generating capacity of 3000 horsepower has already been installed and the plant connected to the system of the Great Shoshone and Twin Falls Water Power Company.

The canal work and excavations for one of the largest power developments in the State have recently been completed at Upper Salmon Falls. This great earth and rock canal will be lined with concrete through its entire length of one and a half miles. It is 42 ft. wide on the bottom, and will carry 5000 second ft. of water with a depth of 12 ft. The plant when finished will have sufficient capacity to furnish 40,000 horsepower. The installation will be one of the most complete and up-to-date hydroelectric equipments yet constructed by the Kuhn Interests.

The Lower Salmon power plant, designed and engineered by the Great Shoshone and Twin Falls Water Company, has a present capacity of 5500 horsepower, which will shortly be enlarged to five times its present size. The available head is 50 ft. The buildings and machinery are of the very best designs and types of construction.

At the Malad River, the Beaver River Power Company has constructed a power house near where the stream flows into the Snake River. The plant contains a 5500 kw. unit. Water is diverted from the flume of the King Hill Irrigation Company by means of a large penstock and only a portion of the available head of the stream made use of. The Great Shoshone and Twin Falls Water Power Company is now constructing a much more extensive development at this point, the water being diverted considerably higher up the river and being returned much further down stream. When completed, the plant of the latter company will be one of the best installations in Southern Idaho, and will be capable of developing at least 15,000 horsepower.

The Idaho Power & Transportation Company has a development on the Upper Snake River near Idaho Falls that supplies electricity for lighting and power service in Idaho Falls, Rigby, Rexburg, Sugar City, and St. Anthony. There are a number of power possibilities on the upper Snake River, but these are in-

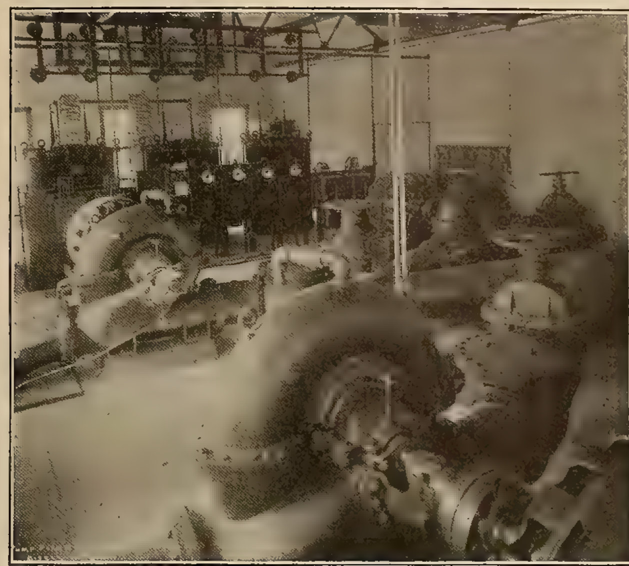
Construction Work on American Falls Power Plant, Nov., 1912.

cluded in the Forest Reserve, and the means by which they are to be developed is a problem of the future.

The Idaho-Oregon Light & Power Company, of Boise, Idaho, produces power from three hydroelectric plants, the Barber plant on the Boise River, the Horseshoe Bend plant on the Payette River, and the Swan Falls plant on the Snake River. These plants have a combined capacity of at least 12,000 horsepower, and may be enlarged to double that amount. The same company has a large power plant partly completed at Ox Bow on the Snake River, which will be capable of delivering at least 30,000 horsepower of electrical energy. The larger cities and towns supplied by this company are Boise, Nampa, Caldwell, Ontario, Payette and Weiser.

The chief hydroelectric enterprises in the southeastern part of Idaho are the Bear Lake Power Company, having a plant on Paris Creek, and supplying Montpelier, Paris and other neighboring towns; the High Creek Power Company, having a plant on Cub River, and supplying Preston, Idaho, and a number of northern Utah towns, and the Telluride Power Company at Grace, Idaho, on the Bear River, which delivers power over a long transmission line into Salt Lake, Utah, and other cities and towns adjacent thereto. The electricity being supplied by these companies is being used very largely for manufacturing and mining purposes and for the operation of electric railway systems in Utah.

Typical Pumping Plant in Twin Falls Country.



Interior Twin Falls North Side Plant No. 2.

Irrigation Pumping.

Pumping plants operated with electric motors and made to irrigate tracts of land on a large scale are a comparatively new means of development. There are at least 150,000 acres of land in Idaho watered by this means alone, and there are at least 200,000 acres of land yet in sagebrush that can be irrigated by no other means. The power companies that have done most to bring about the tremendous development that has taken place are the Great Shoshone & Twin Falls Water Power Company of Twin Falls, Idaho, the Southern Idaho Water Power Company, the Government Reclamation Service of Boise, Idaho, and the Idaho-Oregon Light & Power Company of Boise, Idaho.

The largest pumping project in the world is located near Minidoka, Idaho, and was completed three years ago by the Government Reclamation Service. Forty-eight thousand acres of land are watered under this system with lifts varying from 30 to 90 ft. The High Line pumping project near Twin Falls, Idaho, comprises 4000 acres of land, and is watered with lifts varying from 40 to 80 ft. The Twin Falls North Side pumping project, a Kuhn enterprise, is composed of

Lower Salmon Falls and Power House.

14,000 acres of land segregated under the Carey Act law. The lifts vary from 35 to 90 ft. in height. The Indian Cove project near Mountain Home, Idaho, comprises 4000 acres of land under 100 ft. lift. The Snake River pumping project near Grand View, Idaho, is composed of 15,000 acres of fruit land watered with lifts varying from 40 to 150 ft. With the exception of the Minidoka plant, all the above pumping projects obtain power from the Great Shoshone & Twin Falls Water Power Company.

The larger pumping plants supplied with power by the Idaho-Oregon Light & Power Company are the Payette Heights plant, covering 4000 acres under 140 ft. lift; the Payette Oregon Slope plants covering 7000 acres under lifts of 40 and 100 ft.; and the Kingman Colony plant, covering 2500 acres under several lifts varying from 30 to 70 ft. The same company is supplying power for the operation of many smaller plants, and is preparing to deliver electrical energy to several plants now in course of construction.

One of the largest pumping projects yet to be installed in Idaho and known as the Gem Irrigation Project is now being built near Caldwell, Idaho. It comprises about 35,000 acres of land, and will make use of at least 5000 horsepower of energy for operating the plant.

Electric Heating.

Hand in hand with the development of irrigation pumping enterprises has come the adaptation and general use of electrical energy for heating purposes in the territory supplied by the power companies. It is only in a country where current can be disposed of for irrigation and other uses during the summer that surplus power may be made use of for general heating purposes in the winter season. Nor is this great natural agent being utilized exclusively in the homes of the rich; it is, on the contrary, being enjoyed by all classes of people for heating dwellings, hotels, offices, churches, school houses and other buildings. Electric heating apparatus is comparatively inexpensive to install, and has been found thoroughly clean, safe and economical as compared with fuel heat. It must be tried in order to fully appreciate its convenience and other natural advantages.

Electric Kitchen at Twin Falls, Idaho.

Among the more recent adaptations of electricity is its application to general use in the kitchen. The several power companies have adopted a liberal basis of charge for current used for cooking purposes. An idea of the rapidity with which this means of cooking is being adopted may be gained by stating that in the Twin Falls country alone sixty complete electric ranges were sold by the Great Shoshone & Twin Falls Water Power Company during August and September of the past year.

Electricity on the Farm.

The use of electricity is being adopted very widely on the Idaho farm. It is used for general lighting, heating and cooking purposes and for driving the machinery such as feed grinders, alfalfa mills, water pumps, fanning mills, threshing machines and miscellaneous farm devices. The power companies have been very liberal in extending their lines to the different farms. Especially is this true of the Great Shoshone & Twin Falls Water Power Company, which has constructed many extensions through the more thickly populated agricultural districts depending upon the future development of the territory to warrant the necessary expenditures.

Improvement of Transportation Facilities.

A number of electrical railway enterprises have been in successful operation in Boise and through the neighboring towns and agricultural communities for several years. These railroads are constantly extending their trackage and improving their service. Lately, a number of electric railway enterprises have sprung up in the southern portion of the state in the more densely populated districts. The most recent electric road to be built is in the Twin Falls country. It is being constructed by the Twin Falls Railway Company, and electric trains will soon be running between the city of Twin Falls and Shoshone Falls. The cars will be operated by means of the new Edison storage battery. Twelve miles of grade have been built, the ties laid, and a large part of the rails have been placed. The road is of a gauge that will permit handling standard freight and passenger cars.

With the possibilities for the development of water power enterprises in Southern Idaho and with the unprecedented number of ways in which electricity is being applied to the service of mankind in his industrial and civic life, it is difficult to imagine the wonderful future of the state that will obtain from the further harnessing of the present dormant water power resources and the further education of the public mind in the practical applications of electricity in modern life. It is certain to bring about better and more advanced methods of living; it will encourage and broaden the manufacturing industries of the state; it will increase and improve transportation facilities; and it will remove the drudgery and make farm and home life more attractive. The future possibilities and successes of southern Idaho are interlocked very closely indeed with the wonderful facilities afforded for the development and use of water-power.

ELECTRICAL PUMPING AND IRRIGATION

INLETS AND OUTLETS TO FLUMES.

BY B. A. ETCHEVERRY.

Increased velocity at inlet.

To reduce the cross section and size of a flume it is always desirable, especially for long flumes, to use a high velocity. The maximum velocity will depend on the fall available and on the erosive effect of the water on the material forming the waterway. To change from the canal section to the flume section it is necessary to design the inlet as a transition, allowing sufficient fall in the water surface to produce the increased velocity. For very short flumes it may be more economical to make the flume section more nearly equal to the canal section, for the transition cannot be made abruptly and a long transition may be more expensive than the cost of a larger flume.

Decreased velocity at outlet.

To decrease the velocity at the outlet from the high velocity in the flume to the lower velocity in the canal, one is theoretically justified in providing for a raise in the water surface equal to the difference in velocity heads less the loss in head due to friction and impact in the transition.

Objects of inlet and outlet.

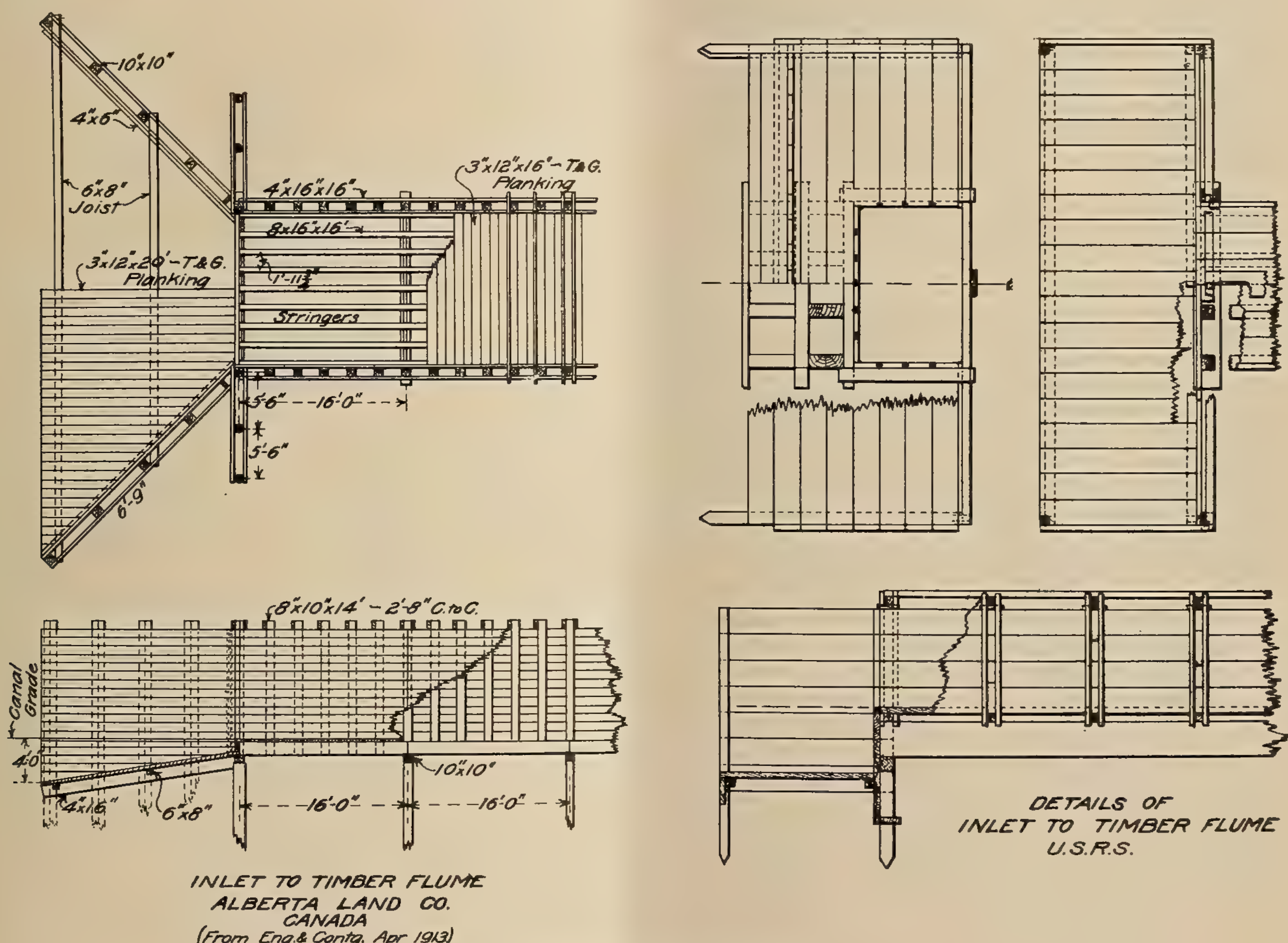
The objects of the inlet and outlet are:

1. To make the change or transition from the canal section to flume section and vice versa.

2. To make connections between the canal and flume and to protect the ends of the flumes.

Design of inlet and outlet.

The inlet and outlet consist of the wings, the floor and the connections between wings and canal.



Typical Timber Flume Inlets.

Form of wings.

To make the transition from the canal section to the flume section, the forms of inlet and outlet wings are: I, Warped wings; 2, Wings placed on an acute angle to the axis of flow; 3, Wings placed at right angles to the axis of flow.

Warped wings or warped channels built of staves or of concrete or of metal are no doubt the best solution, especially for semi-circular flumes, but the increased cost and difficulty of construction are sometimes an objection. However, for a permanent steel or concrete flume the extra cost is well justified, espe-

cially if the available grade is small. Stave warped wings are used only for wooden stave flumes; concrete warped wings may be used for all the types of flumes. Metal warped wings may be used with steel flumes. In changing from a flat canal slope to either the vertical side or curved side of the flume, the slope of the warped surface becomes steeper than the slope of repose of the ground and the warped wing will act partly as a sloping retaining wall, therefore its thickness must be increased with the change in slope and

Steel Flume Inlet With Warped Surfaces, Idaho.

at the vertical end will have the dimension of a vertical retaining wall. Often reinforced concrete warped surfaces with buttresses can be used to advantage. The warped wings should be made sufficiently long to form an angle with the direction of flow not greater than 30 degrees and preferably smaller. Straight vertical wings placed on an angle of 30 degrees to 45 degrees to the axis of the canal have to a certain extent the same effect as warped wings but are not so efficient. Right angle wings are cheap and easy to construct but unless riprap is used at the outlet to form the transition there is a small loss of head due to the sudden change in velocities. Riprap at the outlet is also necessary to prevent the erosion caused by the high velocity and eddies due to sudden change in velocity. If properly riprapped this form may be preferable to the second type. A short length of concrete lining about 3 inches thick is cheap and efficient.

Details of connections and protection of ends.

The proper design and construction is very important, for a large percentage of failures are due to poor connections. When flumes are built across ravines the ends should extend some distance beyond the edges of the ravines. The wings and connections may be made entirely of wood or of concrete. The latter is much preferable. Wood is only used for wooden flumes. Two forms are generally used. The first form consists of the vertical wings placed on an angle of 30 degrees to 45 degrees and of an inclined floor which extends downwards from the edge of the flume floor on a slope of 3 vertical for 10 horizontal. The second form consists of right angle wings extending from the ends of the sides of the flume into the banks and of a cut off apron extending vertically below the floor of the flume. This apron is built with and in the same plane as the wings. This form is cheaper than the first but requires considerable riprap or paving. A third form which has been used successfully is obtained by using at each end a short length of flume whose section is wider and deeper than the main flume, placed so that its floor is 3 or more feet lower than the floor of the main flume. The space above the lower floor is filled up to grade with well tamped earth.

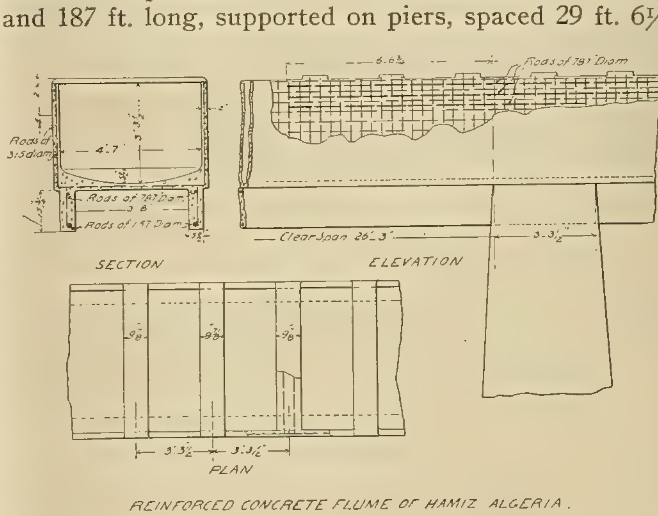
When concrete is used, either the form may be the same as for wood, or warped wings may be used. To connect the end of a wooden flume with the concrete, an abutment wall extends well below the ground surface and supports the end of the floor, the end floor sill being embedded in and bolted to the concrete. The wing wall extends well against the end of the sides of the flume and surrounds the end posts which are bolted to the concrete. To connect the end of a semi-circular steel flume with the concrete the edge of the end sheet should be turned over at least 6 in. and embedded in the concrete abutment on which it should bear for a length of at least 9 or 12 in. For all forms of inlet and outlet it is very important that cut off wings and aprons should extend into the bank and below the bed of the canal to a depth equal to about the depth of water, for ordinary soil. The outlet always requires riprap or bed protection for considerable distance downstream.

Flumes of Escondido Mutual Water Company.

This company has built several small reinforced concrete flumes on the side hill where it is necessary to cross ravines. The clear spans vary from 14 ft. 6 in. to 23 ft. The concrete is composed of 1 part of cement to 2 parts of sand and 4 parts of gravel. The reinforcement consists of corrugated bars. Where the span is wider the flume rests on concrete piers. One flume has a total length of 62½ ft. divided into three spans of 26, 19 and 17½ ft. by two intermediate supports, one a concrete pier and the other a large boulder. The flumes cost about $2.10 a foot, or $21 a cu. yd. Labor averaged $2.50 a day, cement $4 a barrel. Sand and gravel were hauled 1 to 3 miles. The lumber was obtained by tearing down old flumes.

Reinforced concrete flumes on Canal of Hamiz, Algeria.

These flumes carry the water of the main canal over two depressions. The two flumes are 92.5 ft. long and 187 ft. long, supported on piers, spaced 29 ft. 6½



REINFORCED CONCRETE FLUME OF HAMIZ ALGERIA.

in. center to center. The inside dimensions of the flume are 4 ft. 7 in. for the width and 3 ft. 3½ in. for the depth at the center, the flume having a concave floor. The sides of the flume are tied to each other at the top by means of tie beams 9⅞ in. wide, spread

3 ft. 3½ in. center to center. The sides and tie beams are 2 in. thick. The flume is supported on two reinforced concrete beams which form one body with the superstructure. The reinforcement consists of iron rods .315 in. in diameter, placed transversally and longitudinally in the sides and floor, the transversal rods extending into the tie beams. The rods form a net of 4 in. mesh. The beams are 15¾ in. high and 5½ in. wide and reinforced at the bottom with a rod 1.57 in. in diameter, and at the top with a rod .787 in. in diameter. These rods are tied to the reinforcement of the superstructure by means of vertical iron wire .275 in. in diameter. Above the piers to resist the stresses due to the negative bending moment, the reinforcement is strengthened by three round rods .787 in. in diameter, placed in the upper portion of the sides and extending on both sides of the pier for a distance equal to one-fourth of the span.

The mortar used in constructing this flume was composed of 1100 lbs. of cement to 3.2 parts of sand. The total cost was $4.95 a running foot. The flumes were tested when completed and submitted to a load of 1000 lbs. per lineal foot for 24 hours, which they resisted very well.

SUMMARY OF DEDUCTIONS OF IGNITION OF MINE GASES BY INCANDESCENT LAMPS.

Further useful information on causes of mine explosions has just appeared in Bulletin 52 of the U. S. Bureau of Mines on the ignition of mine gases by the filaments of incandescent lamps. The following is a summary of conclusions:

That glowing filaments may ignite gas seems to be proved by the fact that in 58 tests in which the gas was ignited the filaments continued to glow 2 to 59 seconds after ignitions had taken place.

The tests did not prove so conclusively that the spark that occurs when the filaments are broken is not the cause of gas ignition, although the following evidence seems to show that the unassisted spark can not ignite gas: Fifty tests made upon 50, 60 and 120 watt lamps, each of 110 volts, showed a greater percentage of ignitions when the lamps were connected in multiple than when they were connected in series, although the breaking spark was drawn at 110 volts with the lamps in multiple as against 550 volts with the lamps in series.

By breaking a non-inductive 550-volt circuit between a steel contact and a carbon contact, it was found that when the current exceeded 0.15 ampere an ignition was always obtained when the circuit was opened. Yet 10 tests made with five 110-volt lamps connected in series across 550 volts produced no ignition, although the filament of the tested lamp carried one-half an ampere, and the spark must have been drawn at 550 volts. Neither were ignitions obtained from 11 similar tests made with lamps carrying approximately 1 ampere.

The authors believe that the spark that is drawn when a lamp filament is broken is to a great extent "blown out" by the entering current of gas. To prove this assumption, a 50-watt, 55-volt naked filament was connected in series with non-inductive resistance and 0.5 ampere (one-half normal current) at 110 volts was passed through the circuit. The filament was then broken by gradual pressure, which distorted it until it snapped off. Five ignitions were obtained from six tests made in this way. Similar lamps were then connected in series with non-inductive resistance across 550 volts, and the filaments were disrupted by smashing the lamp bulbs. Five tests were made, three with a current of 0.6 ampere and two with a current of 0.7 ampere. No ignition was obtained in any of the five trials, although the current was 20 to 40 per cent greater and the voltage 400 per cent greater than in the five tests that gave ignitions with the naked filaments. It is therefore manifest that the inrushing gas has a quenching effect upon the spark.

Five tests were then made by connecting a 175-watt, 55-volt lamp (normal current 3.5 amperes) in series with a non-inductive resistance of such value that 2.25 amperes flowed through the filament when 550 volts was impressed across the lamp and resistance. The lamp was surrounded with gas and smashed while carrying this current. No ignition resulted from five trials, although the current broken was greater and the voltage ten times as great as in the case of lamps that invariably produced ignitions when broken while burning under normal conditions.

The authors are inclined to believe that the likelihood of gas ignition by standard carbon filament lamps is a function of the cross section of the filaments. The filaments of 24 different types of standard lamps were measured and the cross sections of the filaments were compared to their tendency to ignite gas, as expressed in percentage of ignitions in a given number of trials. All filaments having a cross section of 0.000177 square centimeter or less failed to ignite gas in the series 1 tests. All filaments having a cross section of 0.000234 square centimeter or more invariably ignited gas under the conditions of the series 1 tests; filaments having a cross section of 0.000194 square centimeter ignited gas in 50 per cent of the trials; and filaments having a cross section of 0.000215 square centimeter ignited gas in 83 per cent of the trials. It is true that a similar relation existed between the current flowing in the filaments and the percentage of ignitions that they gave, but the authors do not regard this relation as significant, because they believe that the spark that is drawn when a filament is broken is not responsible for the ignition of gas.

If the bulb of a glowing incandescent lamp is smashed while surrounded by an explosive mixture, and if the filament is not broken by the jar of the blow, the filament is first cooled by the inrushing mixture and then broken by it. Of course the cooling and the breaking are almost simultaneous, but the authors believe that ignition, if it occurs, takes place during the period of cooling and before the filament is broken.

If this hypothesis is correct, there are two reasons why large filaments ignite gas more readily than smaller ones: First, the temperature of the larger filaments will not be so greatly reduced before they are broken; and, second, the larger filaments will not so quickly succumb to the breaking action of the inrushing gas.

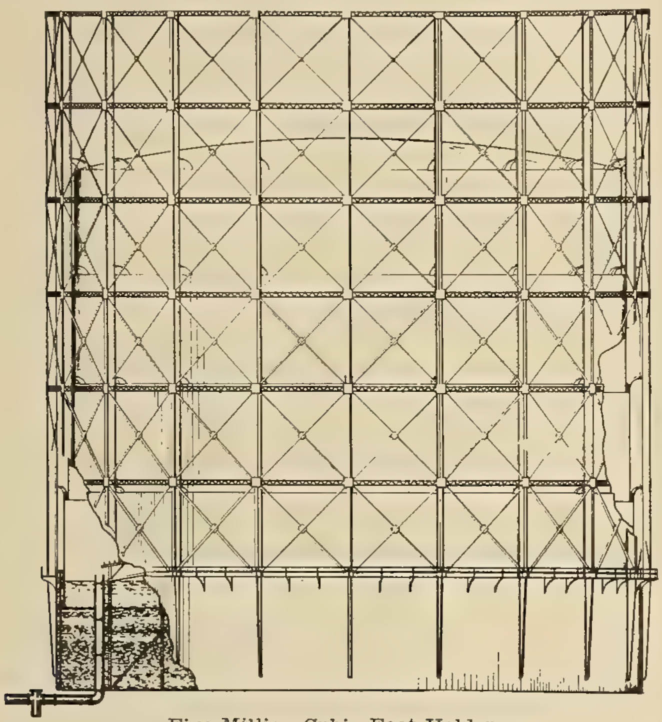
GAS ENGINEERING

DISTRIBUTION OF GAS.—III.

BY E. C. JONES.

The process of manufacturing gas may be said to end with the measurement of the gas by the station meter, and the distribution begins with the gas-holder where the gas is stored.

No objects along the sky lines of cities and towns are more familiar and prominent than the gas-holders, and probably there is nothing so little understood by people in general. There has always been an air of mystery surrounding these receptacles for gas, and they have been considered as dangerous neighbors. Firemen hesitate before fighting fires in their vicinity; while as a matter of fact there is nothing so simple as the principles and construction of a gas-holder, and there is nothing so safe and free from danger of destruction by fire or explosion.



Five Million Cubic Foot Holder.

It must always be remembered that gas-holders are for storing illuminating gas, which will not burn nor explode unless it is mixed or in contact with the right amount of oxygen or air. If it were possible to plunge a firebrand into a gas-holder filled with gas, the fire would immediately be extinguished. If a malicious person should punch holes in the side plating of a gas-holder, and light the gas, it would burn from the orifices the same as from a gas burner, until the holder in emptying extinguished the burning gas by submerging the holes in the water of the tank.

A gas-holder consists of a tank filled with water, and the actual holder or bell which is open at the bottom and is provided with a crown at the top. This bell rises and falls according to the quantity of gas contained in it. The water in the tank prevents the escape of gas, and presents a resisting surface to the gas entering the holder thus causing the holder to rise; it is also the means of expelling the gas as the holder is emptied.

Gas is admitted to and discharged from a holder through inlet and outlet pipes which pass under the tank and up through the bottom of the tank, and through the water in the tank to a point above the surface of the water. These pipes are each fitted with a drip box and valve in the horizontal section of pipe outside of and near the tank. The drip boxes are called dry-wells, and are for the purpose of receiving condensation of water from the gas.

The early holder tanks were built of brick in excavations in the ground. This was before the present age of steel with its wonderful achievements.

The first brick tank was built in 1818 and as the sizes of holders grew with the increasing magnitude of the gas business, concrete was in some cases substituted for brick.

The underground tank had many advantages, chief of which was its durability, for a well constructed tank would last indefinitely, but with the increase in sizes the engineering difficulties were multiplied. There was a lack of uniformity in earth strata, and expense and trouble in pumping and controlling underground water. With the advent of steel plates and shapes of high tensile strength, the all steel tank constructed above ground gradually superseded the underground tank of masonry. Steel tanks are now built upon a concrete pancake, supported by good earth foundation, or resting upon wooden or concrete piles according to the character of the ground, and the element of uncertainty which always confronted the engineers who built masonry tanks, is removed.

The first gas-holders consisted of a single section or "lift" of side plating, and a crown or roof. This holder rose and fell in a water tank a little larger in diameter than the holder, and containing more water than the gas capacity of the holder. It is obvious that these holders were limited to comparatively small sizes, and to economize ground space, and construction materials, the telescopic gas-holder was designed. In this form of holder the tank is made sufficiently large in diameter to contain two or more sections or lifts, one within the other like the extension parts of a telscope, but unlike the telescope the sections are made large enough so that these annular rings move freely without touching. Only the inner or smallest section is provided with a crown or roof, and on the bottom of each section is fastened a hydraulic cup filled with water from the tank. On the top of the second and each succeeding lift is a "grip" formed of channel iron and plates, exactly the reverse of the cup, so that when the inner lift is filled with gas, the cup on the bottom filled with water engages the grip on the top of the second section and lifts it out of the tank, the water in the cup forming a hydraulic seal or joint to prevent the escape of gas. The holder is raised by gas

forced into it by the pressure exerted by the exhauster, and the buoyancy of the gas contributes its share to lifting the holder.

In the days of single lift holders and low gas pressure, the weight of the holder if permitted to rest entirely upon the body of gas contained in it would cause excessive pressure on the street mains, and to avoid this a system of counterweights was used to reduce the weight of the holder. The crowns of early holders were sustained in shape by trusses, but this practice has been discontinued and crowns are now laid out during construction on a wooden framework, supporting rafters cut to the curvature of the crown, erected on and fastened to the bottom of the tank to keep it from floating. When the holder is in commission the gas inflates the crown and it retains its shape. This is known as a "balloon" crown.

Advances in the art of using gas have demanded increased pressure on the street mains, and this coupled with the introduction of sensitive pressure regulators at the outlet of gas-holders, has made it possible to abandon all counterweights and construct holders of many lifts of different weights, so that the pressure exerted by a five lift holder may be five inches on the inner lift and fourteen inches when all five lifts are inflated, without inconvenience to the gas supply.

The largest gas-holder in the world is located at the Astoria Works of the Consolidated Gas Company of New York. It has a capacity of 15,000,000 cu. ft. The next in size is in London, with a capacity of 12,000,000 ft. There is a 6,000,000 ft. holder in Los Angeles, and there has recently been built at the Potrero Station in San Francisco a five lift 5,000,000 ft. holder in a steel tank above ground.

Until recently the pressure with which gas was distributed depended upon the weight of the holder pressing down upon the gas. This varied constantly with the height of the holder, and while it was possible to reduce the pressure by station governors, it was sometimes difficult to maintain sufficient pressure during peak demands, because the pressure could not be increased. The use of a reciprocating pump or rotary exhauster on the outlet of the holder for increasing the pressure was attained with danger of interruption of the gas supply. Such a pump or exhauster when shut down would act as a valve to shut off the supply of gas.

The rotary fan, or the Sturtevant type, is now used as a "booster" for increasing pressure on the street mains. It is placed near the outlet to the holder, and by its use any desired pressure may be maintained regardless of the pressure exerted by the gas holder.

A fan of this kind is so constructed that there is sufficient space between the ends of the fan blades, and the shell of the fan to permit the unobstructed passage of gas in the event of a sudden shut down of the motive power for driving the fan.

Cities and towns are usually supplied with gas through a system of cast iron pipes known as "mains" under a low pressure system. This means pressure as measured by a column of water of from 2 to about 12 ins., or expressed in pounds per square inch from 1/13 to about ½ pound.

The trunk mains leaving the gas works are of the largest size in the district, and are gradually reduced in size as they extend outward into the district supplied with gas. It is essential that the distributing system shall be arranged in complete circuits to provide circulation of gas. A run of pipe not tied into the system so as to make a circuit is known as a "dead end" and these should be avoided as much as possible.

The pipes used for conveying gas were, at first, all of cast iron and were of small sizes, beginning with two inches in diameter. It was soon discovered that cast iron pipe of less than 4 in. internal diameter was not strong enough to withstand the strains due to freezing and thawing or disturbances of the ground, and wrought iron pipe was substituted for the smaller sizes. Cast iron mains are now used for conveying gas for low pressure distribution in sizes from 4 in. to 48 in. diameter, the size of cast iron pipe is always expressed in inches of internal diameter.

Gas mains are laid at an average depth of about 3 ft. cover of earth, above the top of the pipe, at this depth the pipe is secure against surface disturbances due to steam rollers and jars of heavy teaming.

In countries where the ground is frozen in the winter time has been considered necessary to lay gas mains at a greater depth, but experience has proven that mains laid at an ordinary depth are imbedded in frozen earth throughout the winter, while mains laid at greater depths are subject to the strains of frequent freezing and thawing during the cold season. It is a well known fact that frozen ground begins to thaw from the bottom towards the surface from the effects of internal earth temperature.

In laying mains great care is necessary to properly grade the pipe so that any condensation of water will be drained to a low point where it may be removed by pumping it out. On level roads a fall of 12 in. in 600 ft. is sufficient, and in hilly districts the condensation naturally flows to the valleys. The condensation is trapped in a drip box which is a cast iron fitting placed in the line of main, and it is of sufficient size below the main to provide a reservoir for containing condensed water which is pumped out at regular intervals.

A wrought iron pipe extends from the street level, through the cover of the drip-box to within a few inches of the bottom of the drip. An ordinary bucket pump is attached to the top end of this pipe for the purpose of pumping out the water. A record of the quantity of water removed from each drip-box should be kept for reference. Sometimes an unusual amount of water pumped from a drip is due to water leaking into the main from broken water pipes or soil saturated with water, and such a record will often lead to the finding of a broken gas main or defective joint. A well laid main system should have as few drips as possible, and a study of ground levels will often eliminate drips without laying the main too deep or too shallow.

Cast iron pipes are joined by means of a bell

and spigot joint. The spigot or straight end of one length of pipe enters the bell of another length, and the space between the spigot and bell is filled with lead or cement. Cement joints when properly made are as strong as the metal in the pipe, and because of their rigidity any settlement or disturbance causes a broken main. There is some advantage in this as it is much easier to find a large leak than a number of small ones. Cement joints are made by first driving a hard roll of tarred rope into the joint and then filling the joint with a moist mixture of Portland cement and sand, after which another roll of rope is driven in on top of the cement. The joint is then finished and neatly pointed with cement and sand.

Lead joints are made by driving a roll of hemp or tarred rope into the space between the spigot and bell. A roll of soft clay is then placed around the pipe against the face of the bell, and a hole is left on the top, through which molten lead is poured into the joint until it is filled. Atfer the lead has cooled, the clay roll is removed and the lead is caulked into the joint by means of a caulking chisel; this spreads and compresses the lead until the joint is gas tight.

A preparation of lead known as lead-wool is now used extensively for joint making. The lead is in a fibrous condition and is caulked into the joint without heating. There is some saving of time and fuel in making joints in this way, and lead-wool may be used in wet places where it would be difficult and dangerous to use hot lead. Owing to the difference in the coefficients of expansion of iron and lead, the lead joint is never at rest, and small leaks develop. These are not large enough to warrant uncovering the joints and caulking them, but in the aggregate it amounts to a considerable loss of gas.

Cement joints are extensively used in the east and nearly all the cast iron pipe joints in California are of lead. The writer was a strong advocate of cement joints until the earthquake of 1906 demonstrated that mains laid with lead joints are flexible, and the damage done was much less than it would have been had rigid cement joints been used.

All pipes leading from the mains to supply gas to consumers are known as service pipes. They are of wrought iron or steel, and should be connected to the top of the main. The usual method employed is to drill, ream and tap a hole of the required size by means of a simple drilling machine attachable to the main. The male end of a street elbow is then screwed into the main and a second street elbow is then screwed into the first. This forms an almost universal joint, capable of movement in any direction without straining or breaking the service connection or main.

Services should always be laid so as to drain back to the main and should have as much fall as possible. All large services should be provided with a valve at the curb line for the purpose of quickly shutting off the gas in case of fire or other emergency. Ordinary service pipes were formerly ½ in. to 1 in. in diameter. This was in the days when gas was used almost exclusively for illumination, and the demand extended evenly over a long period from sunset to the time of retiring.

Gas now occupies almost exclusively the field of domestic cooking and water heating. Its importance for heating is rapidly growing, while it still retains an important and ever increasing part of the lighting business. This last was made possible by the timely invention of the incandescent mantles by Dr. Auer von Welsbach. These new uses for gas have changed the hours of gas consumption from the long lighting load to three distinct peak periods, due to the preparation of the three meals each day. These peak demands and the large momentary use of gas by automatic water heaters have necessitated the use of larger mains and service pipes. The smallest service now installed to insure an ample and uninterrupted supply of gas is 1¼ in. in diameter.

Wrought iron or steel pipes laid in the ground must be protected from oxidation, and every kind of paint has been tried as a preventive. Probably the best coating for iron or steel surfaces is made in the gas works and is a by-product of the business.

Oil tar when boiled in a still is freed from water, benzole, and some of its lighter oils, and when cooled the remaining tar is thinned by mixing with it a portion of the benzole taken from it. This makes an excellent paint and may be applied to the pipe by dipping or by means of a brush. For a second coat, tar is boiled down to a medium pitch, and this pitch is applied while hot in a heavy coat from one-eighth to one-quarter inch thick. This hot pitch will not adhere to the metal surface, but when applied over a coat of the tar paint it melts and amalgamates with the paint forming a rust proof coating, which in itself is neutral, that is, it contains no ingredients which will corrode iron or steel. Where oil gas is made this coating is asphaltum, and if coal gas is made, coal tar and coal tar pitch may be used with equally good results. This coating is a poor conductor of electricity, and in a measure prevents the effects of electrolysis on the metal pipes.

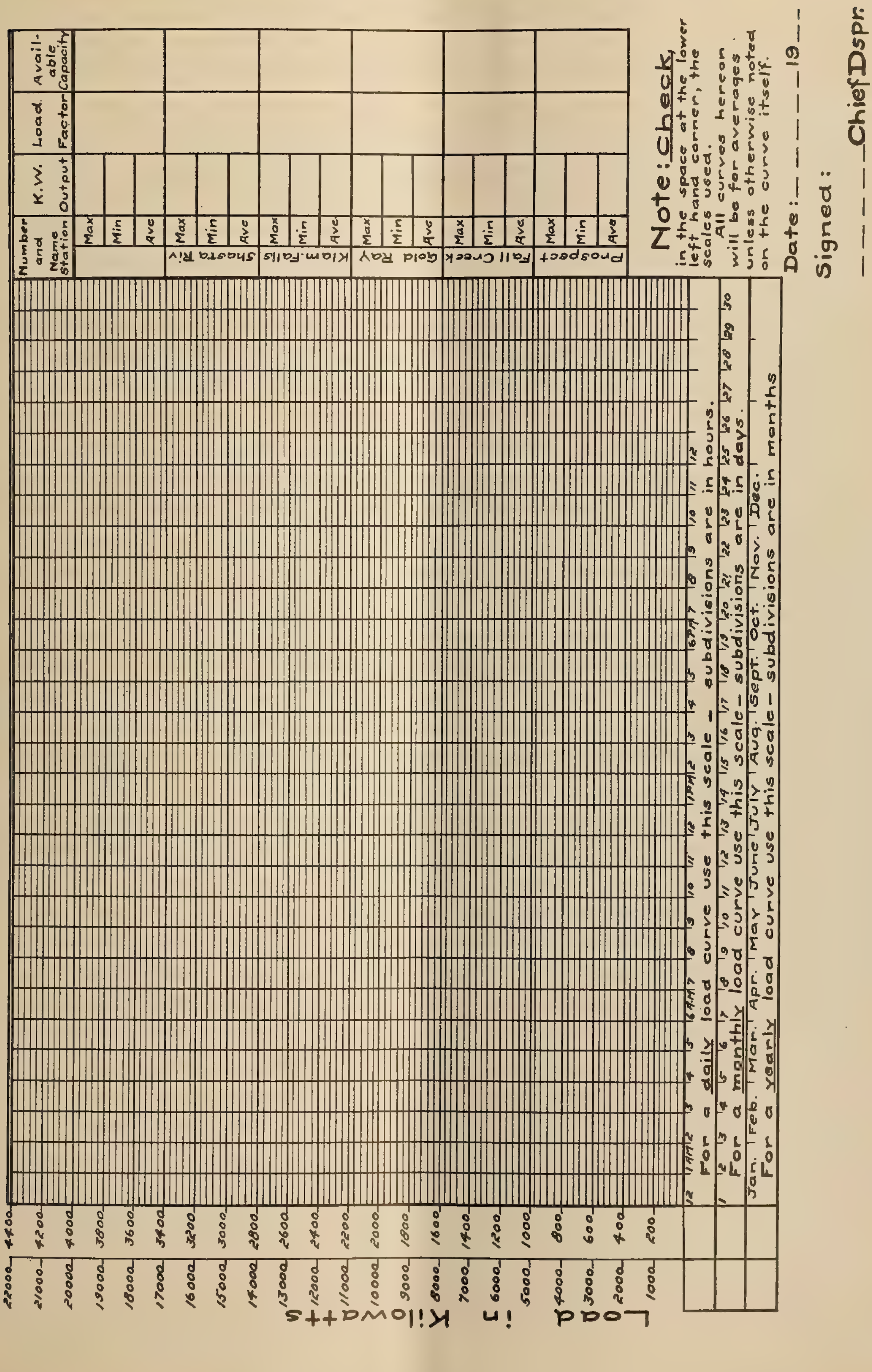
(To be continued.)

STANDARD LOAD CURVES.

Power plant operators do not like to write, and anything that simplifies record-keeping in the plant is welcomed by the operator. The California-Oregon Power Company is now using the accompanying chart as a standard in all their power plants to minimize the operator's work. Under the direction of Sidney Sprout, consulting engineer for the company, Mr. J. C. Boyle has worked out the details.

Inspection will show that this chart may be used to plot either a daily, monthly or yearly load curve, either maximum, minimum or average for any plant in the system. The lower edge of the diagram is laid off with three scales, one being subdivided into hours, the other into days, and the other into months, which are used respectively for daily, monthly or yearly curves. The left-hand vertical edge comprises a double scale, reading either from zero to 4400 kw. by 200 kw. intervals, or from zero to 22,000 kw. by 1000 kw. intervals.

This diagram has been standardized for use in each one of the plants, and is quickly filled in by an operator, who merely has to plot the corresponding points and make the required check mark.



Standard Form for Plotting Load Curve.

LOCATING FAULTS IN UNDERGROUND CABLES

DETAILS OF THE MURRAY LOOP METHOD—II

BY C. A. GAINES.[1]

In the use of resistance tests to locate faults in large underground cables, special precautions must be taken to eliminate errors due to the connections necessary to perform the test, and it is the purpose of this article to explain some of the methods used to accomplish this result. Before proceeding further in detail I shall review several points I brought out in a paper upon this subject that I read recently before the Pacific Gas & Electric Company's Branch of the N. E. L. A.

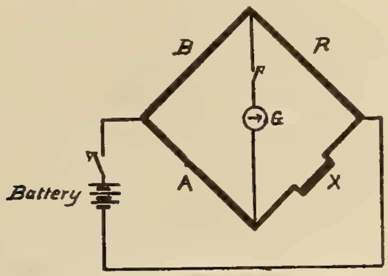


Fig. 1. The Wheatstone Bridge.

It is a well known fact that a cable tester, who regularly locates trouble on a telephone cable within a few feet of the actual fault, cannot come within a few hundred feet of the fault on a power cable, and the reason for this is plain when we consider the quantities with which he has to deal in each case. No. 22 copper telephone wire has a resistance of 85 ohms per mile, but a No. 2/0 conductor has only .41 ohms for the same length. One foot of No. 22 has a resistance of .016 ohms, while a foot of 2/0 has but .000078 ohms resistance.

Suppose the bridgeman uses two 6 ft. leads of No. 10 copper for connecting between his test set and the cable. These will have a combined resistance of .012 ohms, neglecting the contact resistance where they are all attached to the cable conductor. This resistance represents two-thirds of a foot of No. 22, a value which can well be neglected, and 154 ft. of the No. 2/0. In addition to this we have also to consider the connection at the other end of the cable where two conductors are tied together to form a loop.

It usually happens that the terminals of a power cable available for connections are either the knife blade of a disconnecting switch, or some threaded bolt, the nut of which must not be loosened for fear of putting out of alignment the blade or jaws of the switch. The tester, on the other hand, is confronted with the question of making a good electrical connection with negligible resistance, or else the question of eliminating the contact resistance at the same time that the correction is made for the resistance of the leads. The value of the contact resistance usually varies from .001 to .002 ohms, but may be many times that value. When the connections can all be clamped under nuts, or in other ways made secure, this contact resistance need not be considered. In fact if it never became greater than .002 ohms one could usually neglect it as this represents but 25 ft. of No. 2/0, but it is so liable to be greater when you least expect it that time will be saved in the long run by including it in the test for the resistance of the leads.

Another reason for the more satisfactory results obtained with telephone cables when locating trouble is due to the fact that the Wheatstone bridge is more accurate when measuring resistance from one ohm to 100 ohms than when dealing with values from 1.0 ohm to .01 ohms. The two most common tests—the Murray loop and the Varley loop—are both based upon the well known principle of the Wheatstone bridge, in which three known resistances with one unknown resistance, arranged as shown in Fig. 1, are adjusted until, with battery key closed, there is no deflection when the galvanometer key is closed. When such a balance has been obtained the four resistances are related to one another as shown in the equation $A/B = X/R$, and therefore

$$X = \frac{AR}{B}$$

A convenient Wheatstone bridge can be made by stretching a piece of resistance wire between two terminal blocks, fastened at each end of a scale, preferably divided into 100 units, and the battery connection arranged to slide along this wire. This slide wire takes the place of A and B in Fig 1, and the resistance R (Fig. 1) is supplied by some known resistance, which may or may not be adjustible.

In both the Murray and the Varley tests a loop is formed by joining the faulty conductor with a good conductor at the farther end of the cable. This connection should have as low a resistance as possible, particularly when using the Murray loop test. This

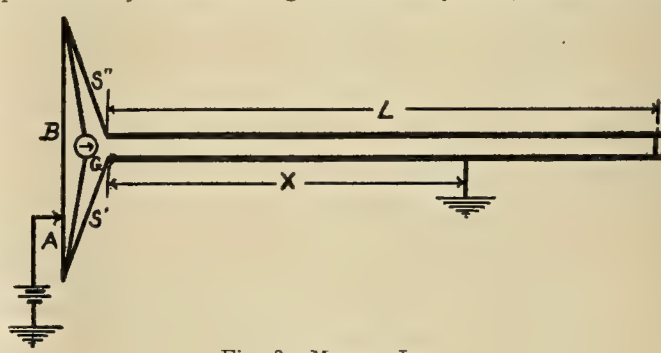


Fig. 2. Murray Loop.

latter method of testing is by far the most simple and readily understood, and particularly adapted for use with a slide wire bridge, for with this form of bridge, with a 100 unit scale, the reading obtained on the slide, gives the distance to the fault directly as a per cent of twice the length of the cable.

The connections for the Murray loop test, using a slide wire bridge, are shown in Fig. 2, in which "A" and "B" together represent the slide wire; S'

[1]Cable testing expert for the Pacific Gas & Electric Company, San Francisco.

and S″ are the leads to the cable; L is the length of the cable in feet and X the distance to the fault in feet.

In order to eliminate the error due to the leads S′ and S″, the bridge wire can be calibrated to include them and a correction curve made as in Fig. 3. The connections are then made as in Fig. 4.

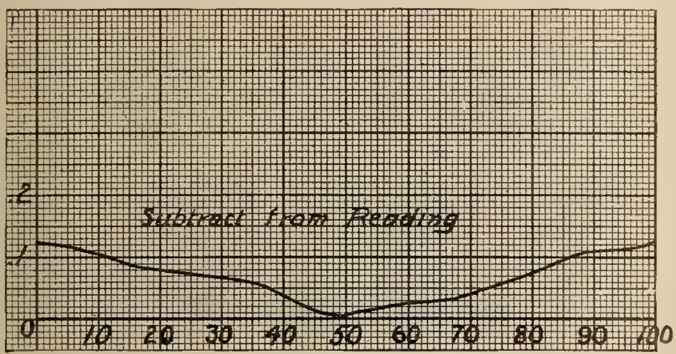


Fig. 3. Chart for Murray Loop.

In using the Murray loop test the battery connection is moved along the slide until the galvanometer is not deffected and we then have the length of cable as far as the fault balanced against the remainder of the cable loop in the same proportion as A is to B.

$$A/B = \frac{X}{2L - X}.$$ If this is true, then the proportion

$$A/A + B = \frac{X}{2L - X + X} = \frac{X}{2L}$$ is also true, and we have X in feet.

$$X \text{ in feet} = \frac{2AL}{A + B}$$ in feet. As mentioned before, if

$A + B = 100$, then $X = A\%$ of 2L.

It should be noted that with the slide divided into 100 inches, 100 centimeters, or 100 units of any size, that A is a per cent of twice the length of the cable m. It is a very common error to forget that

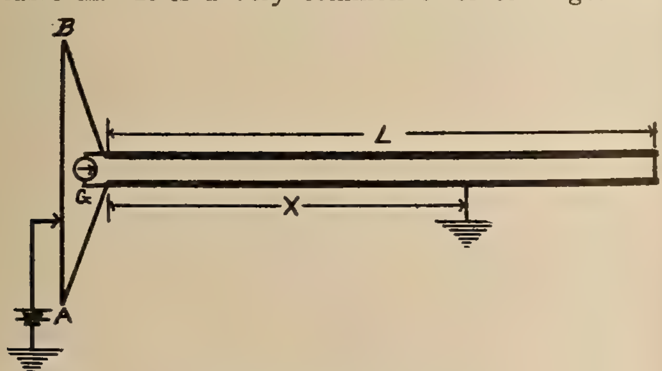


Fig. 4. Connections for Murray Loop, With Leads as Part of Bridge Wire.

"two." Where a bridge is made especially for fault location it can be divided into 200 divisions and the equation becomes $X = A\%$ of L, and that troublesome "two" is eliminated.

Suppose a fault develops in a cable midway between two stations, then with a 100 centimeter bridge A will be 25 cms., giving the distance to the fault as 25% of 2L, which reduces to 50% of L. With the 200 centimeter bridge A becomes 50 cms and the distance to the fault is directly 50% of L.

The slide wire bridge will be found to be more accurate if the resistance of the entire bridge wire is approximately equal to the resistance of the cable loop, and in designing a bridge for cable testing one should calculate the average resistance of the cables upon which it is expected to use it and select a resistance wire accordingly. For power cable work one should also endeavor to get a bridge with as large carrying capacity as possible, so that a current can be used giving an appreciable drop in the large conductors found in power work.

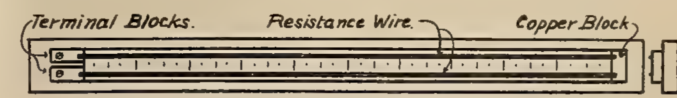


Fig. 5. Simple Method of Slide Wire Bridge.

A simple method of constructing a 200 unit bridge is shown in plan view in Fig. 5. The two resistance wires stretched along the 100 CM scale are joined by a heavy copper block at one end, and terminate in two heavy terminals at the other end of the scale.

In an emergency a length of bare copper wire can be attached to one conductor and run around the room, returning to the other conductor of the cable loop. Any d.c. source can be used to furnish current, one side being grounded and the other one through a bank of lamps, or some other convenient resistance, arranged to move along the bare wire until a balance is obtained, as shown by no deflection of the sensitive voltmeter which is connected to the two terminals of the cable loop. The ratio of the shorter length of the bare copper wire from the sliding connection to the cable, to the entire length of bare wire, is the same ratio between the distance to the fault and twice the cable length.

OIL PRODUCTION RAPIDLY INCREASING IN MEXICO.

Shipments of crude petroleum from this district steadily increase. During the last quarter of 1912 declared exports to the United States of crude oil amounted to 1,568,169 barrels and through the Tuxpam consular agency 1,337,182 barrels. In addition the Waters-Pierce refinery has been taking about 6000 barrels and the railway company about 12,000 barrels daily. Consumption from these sources amounted to about 1,656,000 barrels during the same period. In addition a considerable amount of crude oil was shipped to the Pearson refinery at Minitatlan, while a much greater amount was shipped there during the first quarter of 1913. A conservative estimate as to crude oil shipped from and consumed in this consular district during the December quarter would be about 5,000,000 barrels. This will probably be greatly exceeded during the first quarter of 1913. Because there are only 22 ft. of water at La Barra at Tampico, while at Tuxpam oil tankers can be loaded at sea. Tuxpam is rapidly displacing Tampico as the leading port for shipping crude oil.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

Labor Disputes and the Regulating Commission

A situation has developed in California during the past week that materially concerns every public utility company of the West. The status of affairs is about as follows: An organization, hailing itself as the Light & Power Council of California and constituted largely by the gas makers, electricians and other labor elements of one of the largest distributers of gas, water and electricity in the West, has openly demanded, without admitting any possible recourse to arbitration, an increase in daily wage and a relief from labor one day in seven with full pay.

That this group of men is in nowise connected with any hitherto recognized labor organizations and thus summarily make such demands adds another entanglement to the problem. Casting aside this phase of the situation, however, the question of the wage scale and its increase or decrease constitutes in itself a grave and mighty problem not alone to the utility company and its employes but to the thousands upon thousands of consumer citizens it serves.

If these men are not receiving a proper wage an injustice is being done them and they should find relief. On the other hand, the citizens at large, who under commission regulation must provide the utility company with a fair return over and above operating costs, are grievously wronged if there is no justice in the contention. Hence the real parties to the issue are the employes of the utility company and the consuming public.

There is no possible method of equitable rate-fixing that prescribes the upper limit of revenue which a corporation may receive without being sure of the outgoing expenses. It is as futile as an attempt to measure an Hawaiian rainfall by means of an upturned barrel without at the same time measuring the water that escapes through the open bung-hole. That there is often justice in the demands of labor no one can deny. That the people, too, under commission regulation, are likewise deeply involved everyone must equally admit.

It would seem, then, that our effective commission regulation only half-way serves its usefulness. That this selfsame commission should in addition be empowered to review labor contentions with public utility companies with full and complete powers to act, seems both rational and reasonable in order to dispense justice to utility, employe and public alike.

A Forceful Publicity Campaign

Public enlightenment means much to the modern utility company. A forceful illustration is to be found in a recent publicity campaign at Pomona, California. In this municipality of about 15,000 inhabitants, situated near the famous San Antonio plant, the mother of modern long distance hydroelectric installations, the socialistic element endeavored to arbitrarily reduce the rates of the Southern California Edison Company, the utility organization serving the city of Pomona.

Upon this element appearing before the city fathers, the city council said that it did not believe its members were qualified to pass upon the questions

but suggested that the powers of regulation be transferred to the railroad commission of the state by popular vote. The socialists, however, preferred to submit ordinances to the citizens at the regular municipal election. These proposed to make the gas rate 90 cents instead of $1, the base rate for electricity 5½ cents per kw.-hr. instead of 8 cents, and a reduction of about 25 per cent in the water rates. The proposed rates were determined, apparently, without special investigation or knowledge as to whether they would produce a fair return upon the investment.

The campaign and contentions of the Edison company, on the other hand, were scientifically conducted. An expert was put directly in the field. Sworn statements were laid before the people showing the operating expenses of the Pomona district for 1912; also figures bearing upon the investment values as appraised by Bion J. Arnold. The rate of return earned upon the investment was shown, contrasted with the prevailing rates upon which money could be borrowed in Southern California. Indeed the entire proposition was discussed as frankly as one business man would present a business proposition to another, The result of the election fully vindicated the general policies and methods of the Edison company, for the measure was defeated by a two to one vote.

This decisive victory must have a far reaching effect throughout the utility life of the West. Other utility companies would do well to heed the methods made use of in this notable campaign.

Two other interesting facts may be seen in this battle that clearly portray the trend of the times—the desirability of a small municipality to have its utility affairs under the state wide commission, and the necessity of a utiltiy company to be just and reasonable in its charges.

The many good points to be gained by a municipality placing its rate-fixing powers with the state commission have been too frequently emphasized in these columns to bear repetition. On the other hand the incident should be allowed to pass without calling attention to the necessity of reasonable and just procedure on the part of the utility company at all times. In these latter days when bitter political contentions may arise at a moment's notice, the all powerful weapons of truth and justice are necessary to win the day.

The A. I. E. E. Dispute

In a recent issue attention was called to the recent court action brought by certain Institute members to annul all transfers that have been made under the special section which has been in effect since June, 1912, and which expired on May 1, 1913.

Since the legality of transfers has been now questioned it would seem that all bitterness and personalities should be avoided. The issue is plain. The only true value that any honor has is that it may prove genuine. It may be true that some unqualified members have slipped into the wrong classification. This in itself is not so much to be deplored, however. That the great majority of transfers are justified, cannot be disputed; hence if there is the least question of a doubt as to their genuine legality, is it not best for the courts to pass on this question and settle it for all time?

Public Quality of A Public Service Corporation

A radical change is taking place in the public conception of what should constitute a public service corporation. It may be five years or more before this idea becomes a living fact, but that is no reason why corporation officials should not recognize its existence and prepare for its advent. The responsibility rests largely with corporation directors and managers themselves whether this country is forced into public ownership and operation of public utilities or whether it can continue to be benefited by private initiative, private enterprise and private capital as applied to the public service.

Until recently, it has been taken for granted that furnishing light, heat or power was just as much a branch of private business as supplying milk, butter or eggs. This has been practically the theory underlying the laws and this has been the opinion of those who built the power plants.

But if this assumption is correct, why should the people object to rate discrimination between large and small consumers? Has not all commercial business been reared upon the firm foundation that goods can be sold more cheaply at wholesale than at retail? Does not every public utility manager know that it costs more to supply electricity to twenty small light consumers than to one large power consumer? If, then, the supply of electric light and power is a private business, why shouldn't the largest consumer be given the lowest rate?

Yet we know that a corporation upon which everyone is dependent for service can be made the means whereby the big fellow can drive the little man out of business. Consequently, a few far-seeing men are beginning to recognize that an electric light and power company should not be considered as conducting a private business; rather should it be looked upon as the private agent carrying on a part of the public business. The public wants equality of rates for public service as distinguished from the necessary rate discrimination in private business. In other words, the public quality of the management is to be made paramount to its business quality.

This difference is well illustrated by the postal service or by the tariff. No discount is given to large purchasers of postage stamps, nor does a large importer pay a lower duty than a small importer. Suppose, however, that the small man was discriminated against in price, would he not be soon driven out of business by such methods? But is not that precisely what the public service corporations are doing, and is that not why the public are no longer willing to concede that the supply of electricity is no longer a private business? Does it not also behoove the corporations themselves to recognize that they are only the private agents doing a part of the public business?

Public service commissions already regulate the finances and service of such private management and the day is not far distant when the governmental stamp of approval will give the same endorsement as to the stability of their securities as it now does to government bonds.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Karl Waechorst, an electrical engineer of Dusseldorf, Germany, is at San Francisco.

C. A. Walker, president of the Ely Light & Power Company of Ely, Nev., is at San Francisco.

K. G. Dunn, vice-president of Hunt, Mirk & Co., has returned to San Francisco from San Diego.

H. G. Aylesworth, Pacific Coast representative of several Eastern electrical manufacturers, is at Los Angeles.

W. R. Hamilton has recently joined the sales organization of Pierson, Roeding & Company at San Francisco.

Fred Leggatt, Pacific Coast manager of the Western Electric Company, is expected to return from an eastern trip on May 17.

Carl Bush of the A. G. Electric & Manufacturing Company, Seattle, is in Portland looking after the interests of the company.

F. L. Whipple of the Northwestern Electric Company has been elected secretary of the Jovian Luncheon Club in that city.

Allan M. Culver, head of the Denver Gas & Electric Company, was at San Francisco during the past week with Mrs. Culver.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, has returned from a trip through the northwest.

Sidney Sprout, consulting engineer at San Francisco, is investigating an irrigation project in Arizona where a big dam is to be built.

R. H. Walker, manager Columbia Electric Company at Seattle, was at Forts Casey and Ward recently where the company has contracts for wiring on the fort buildings.

C. S. Bowie of Bowie & Love, electrical jobbers and supply dealers of Tacoma has just returned from a business and pleasure trip of 8 weeks' duration throughout the east.

F. T. Caldwell, superintendent of the Home Telephone & Telegraph Company at Spokane, Wash., has been appointed superintendent of telephones at Edmonton, Alta., Can.

W. N. Landerkin, formerly with Fairbanks, Morse & Company at Vancouver, B. C., has taken the position of traveling salesman for the Pacific States Electric Company.

E. L. Barnes, district manager of the American District Steam Company at Seattle, has returned from a business trip through Idaho, Western Montana and Eastern Washington.

Harry Byrne of the electrical department, Allis-Chalmers Manufacturing Company, New York, is making a pleasure trip along the Pacific Coast, spending some time in Seattle recently.

C. P. Deming, formerly with the General Electric Company Seattle, is now connected with the Fort Wayne department of the General Electric Company ot 326 Colman building, Seattle.

G. B. Rosenblatt, commercial engineer of the Westinghouse Electric & Manufacturing Company, connected with the Salt Lake office of the company, has just retnrned from a trip to Alaska.

C. F. Gilcrest, instructor in the electrical engineering department of the University of California, has been made head of the meter department of the San Joaquin Light & Power Company at Fresno, Cal.

Frank S. Drake of the Harriman electric system at Portland has been selected as superintendent of the Yakima Valley Transportation Company at North Yakima, Wash., to succeed **W. C. Baker** who has accepted a position in the east.

R. M. Buehler, formerly local district manager for the Mountain States Telephone & Telegraph Company at Phoenix, Ariz., has been transferred to Prescott, where he will fill the position of district manager. **W. Cockrell** will succeed Mr. Buehler at Phoenix.

E. A. Norton, sales manager of the Pacific States Electric Company at Seattle, and **Ross Hartley** and **F. J. Airey**, sales managers of the firm's houses at Portland and Los Angeles, respectively, are in San Francisco, attending a meeting of the concern's sales managers in the latter city.

W. R. Hendrey, for five years manager of the Seattle office of the Fort Wayne Electric Works and Sprague Electric Works, of the General Electric Company, has severed his connection with the above company to engage in electrical engineering and construction business in the Northwestern States with headquarters at 325 Yesler Way, Seattle. **H. L. Eicher** has been appointed manager of the Seattle office of the Fort Wayne Works.

M. L. Baden, Riverside; **F. P. Bailey**, Healdsburg; **J. F. Ball**, Sebastopol; **H. G. Baugh**, Petaluma; **G. J. Bundy**, Bakersfield; **H. T. Carlton**, Napa; **N. Cleveland**, Oakland; **D. I. Cone**, Berkeley; **T. B. Copeland**, Oroville; **P. L. Davis Jr.**, San Francisco; **F. B. DeLano**, San Francisco; **F. L. Gautier**, Oakland; **M. S. Gerend**, Berkeley; **R. C. Griffin**, Oakland; **C. Grunsky**, Stockton; **G. H. Hagar**, Anaheim; **G. A. Howell**, Stockton; **E. L. Hughes**, Red Bluff; **E. T. Kavanagh**, Vallejo; **C. I. Kephart**, San Francisco; **B. F. Kline**, Sacramento; **R. G. McCurdy**, Eureka; **T. L. Moody**, Laton; **J. W. Morton**, Oakland; **A. J. Twogood**, Riverside; **H. L. Weber**, San Francisco and **M. Young**, Carpinteria, have been granted the degree of Bachelor of Science in the College of Mechanics of the University of California.

OBITUARY.

Charles W. Van Norden, clergyman, author, educator and pioneer in high tension electrical transmission in California, died at Auburn, Cal., May 12, 1913, aged 69 years. Rev. Van Norden was born in New York State, and was for three years president of Elmira College, New York. He came to California in 1893, and held several Congregational pastorates in the Sacramento Valley. He was one of the prime movers in the formation of the Central California Power Company, whose plant at Alta was constructed by his son, Rudolph W. Van Norden. Before this system was taken over by the present Pacific Gas & Electric Company he was president of the company, and in 1901 he was elected president of the Pacific Coast Electrical Transmission Association. He is survived by a widow, three sons and two daughters. His life has been one of service and inspiration to mankind, and the world is better for his having lived in it. More cannot be said of any man.

MEETING NOTICES.

Portland Section, A. I. E. E.

The annual meeting of the Portland Section of the American Institute of Electrical Engineers will be held at the Hotel Oregon, Tuesday, May 20, 1913. The principal features of the evening will be an informal banquet, commencing at 7 P. M. sharp, entertainment all evening, and election of officers—after the banquet.

Jovian Rejuvenation at Los Angeles.

Thursday, May 22d has been set as the date of a big Jovian Rejuvenation at Los Angeles, when it is hoped to

initiate a class of fifty or more. The ceremonies will be held at the Union League Club, corner Second and Hill streets, beginning with the banquet promptly at 6:30 p. m.; this to be immediately followed at the same place by the initiation ceremony. All visiting Jovians are extended a very cordial invitation to attend. R. B. Clapp is Statesman.

Oregon Society, Engineers.

The regular meeting of the Oregon Society of Engineers was held Thursday evening, May 8, in their club rooms, 247½ Stark street. The meeting was addressed by Mr. Joseph N. Teal, president of the Oregon Conservation Commission. Mr. Teal discussed both federal and state conservation and declared that there should be both co-ordination and co-operation in development of the natural resources of the West. "When the government is about to build an inland waterway," he argued, "it should go a step farther and, if practicable, use some of this same energy in providing irrigation for nearby arid lands." He also emphasized the necessity of preserving the forests.

Oregon Technical Club.

The regular weekly luncheon was attended by a goodly number and those present were treated to a fine talk by Prof. F. L. Griffin of Reed College. His subject was "Modern Ways of Teaching Mathematics." Prof. Griffin believes in teaching in the various grades mathematics which can be applied to every day subjects about the student. That is, every part of the mathematical course should be complete in itself and the student should be able to apply same to practical, every day subjects and problems about him. The chairman of the day was J. R. Thompson. The luncheon took place on Monday instead of Tuesday, as announced previously.

Seattle Jovian League.

The Seattle Jovian League was addressed at its luncheon given May 9th by E. K. Nnoff, sales agent of the U. S. Steel Products Company, the company being host at the luncheon. Mr. Knoff's address dealt with some of the points involved in the manufacture of certain electrical wires and the drawing of steel and copper wires. The process of drawing to bring the wire to the proper diameter was fully explained. The various phases of insulation were also discussed at some length in the carefully prepared address. Thomas H. Bibber, sales manager of Edwards & Company, Inc., New York, statesman at large, was present and addressed the league, giving a brief history of the organization. Until further arrangements are made meetings will be held every two weeks instead of every week as heretofore.

Electrical Development and Junior League of San Francisco.

The monthly business meeting was held last Tuesday. Reports of standing committees were heard and adopted. The Code Committee reported the probable adoption of the proposed license ordinance by the Board of Supervisors. Mr. W. S. Berry, chairman of the committee having in charge the settlement of the differences between the central stations and contractors, with respect to service installations, reported a satisfactory solution of the question.

Suggestion was made that steps be taken looking toward the provision of a "house electrical," or Jovian headquarters at the 1915 Exposition, where all local as well as visiting Jovians and friends might be made to feel at home while visiting the fair. It is anticipated the suggestion will soon resolve itself into active shape and committee appointed to take up the task.

Portland Jovian Luncheon League.

The regular Thursday luncheon was held at the Portland Commercial Club. Mr. R. E. Halliday of the Federal Sign Company spoke on "The Development of the Federal Sign," and said in part:

The first Edison electric generator was installed in Abington, Wis., in 1886. The first electric sign installed in the United States was installed in 1890. Last year there was manufactured in the United States 80,000,000 incandescent lamps, while 8,000,000 are installed in electric signs. At present there is invested in electric signs in the United States $30,000,000. There is going to be a campaign on in Portland to install electric signs for large spectacular effects and endeavor to rival New York with these signs in some particular cases.

A motion was made and carried that the luncheons be discontinued during the summer, the same chairman and executive committee to hold over the summer, meetings to be called again in September.

BASEBALL AT PORTLAND.

The Pacific States Electric Company's crack baseball team went down to defeat before a team picked from the other electrical jobbing houses of Portland, last Saturday afternoon, the 3d, at Sellwood Park. The score stood 24 to 16 in favor of the "scrub" team. The winning team is to be dined by the losing team.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Jacob Swallow, Mae Laws and Clarence W. Martin have filed a complaint against the Economic Gas Company of Los Angeles. They ask that the commission deny the application of the Economic Gas Company pending before it to issue bonds, and that it further find the office of the Economic Gas Company in contempt and penalize them for having issued securities, according to the complaints, without the consent of the commission.

The Palo Alto Gas Company has filed a complaint against the Pacific Gas & Electric Company, which was serving gas to the Palo Alto Gas Company at wholesale at 75 cents, and the Palo Alto Gas Company was retailing it to its consumers at $1.50. Thereafter the railroad commission reduced the rate in the city of Palo Alto to $1.20. Since then the Palo Alto Gas Company has offered the Pacific Gas & Electric Company 54 cents per 1000 feet, but the Pacific Gas & Electric Company has demanded 60 cents. The Palo Alto Gas Company now asks the commission to compel the Pacific Gas & Electric Company to accept 54 cents per 1000 feet.

The Great Western Power Company has applied for authority to use $225,000 of bonds, previously authorized, to reimburse its treasury for expenditures from income during the months of December, 1912, and January and February, 1913.

Authority has been granted to the Union Home Telephone & Telegraph corporation of Southern California to issue bonds to the amount of $161,000 to replace bonds which were borrowed.

The commission has granted the application of the Arizona-California-Nevada Telephone Company to sell its plant in Needles, Cal., to the Needles Gas & Electric Company.

The commission has granted the application of the Citizens' Light & Water Company to sell its property to the Claremont Domestic Water Company for $70,000.

Authority has been granted to the Mount Konocti Light & Power Company to issue $20,000 in stock and a promissory note for $5000. The proceeds from the sale of the stock are to be used in extending the company's lines. The company now operates in and around Lakeport and proposes to operate in Kelseyville, Upper Lake, and to extend its system into the mineral springs resorts of Lake county.

Application has been made by the Pacific Gas & Electric Company for authority to issue $5,000,000 of 6 per cent 10 year debentures. The company proposes that $3,750,000 shall be used for the reimbursement of the treasury for expenditures made from income. The balance of 1,250,000 is to be used by the company in general improvements over its system.

It is provided that the debentures shall be convertible into the common stock of the company on or before June 1, 1917, at $80 per share, between June 1, 1917, and June 1, 1919, at $85 per share, between June 1, 1919, and June 1, 1921, at $90 per share, and after June 1, 1921, at $95 per share. The company asked authority, for the present, to pledge the debentures as collateral security for notes to the amount of $4,000,000.

TRADE NOTES.

The city of Seattle has bought 12 Allis-Chalmers Co. air brake equipments, provided with emergency valves for the city's proposed municipal railway.

The Mumby Lumber & Shingle Company at Bordeaux, Washington, has ordered a 500 kw. turbine with exciters, switchboards, etc., from the General Electric Company.

The U. S. Reclamation Service has purchased of the Allis-Chalmers Manufacturing Company, nine motors and nine transformers for the Lake Keechelus project in central Washington.

Charles C. Moore & Company, engineers, Seattle, have the contract for an extension to the municipal lighting and power plant at Kamloops, B. C., same to be 600 kw., 80 per cent power factor.

The Northwestern Improvement Company has ordered from the General Electric Company a 1000 kw. turbine, generator sets, switchboards, etc., to be used in its mines at Roslyn, Washington.

Paine, Bailey & Co., 440 Market street, San Francisco, and F. F. Foster & Co., 443 East Third street, Los Angeles, are now carrying a complete stock for the Paragon-Sellers Company of Chicago.

The Westinghouse Electric & Manufacturing Company, Tacoma, is furnishing 20 alternating current motors to be used in the new F. S. Harmon & Company furniture factory at Tacoma. These motors vary in size from 1 to 25 h.p.

The Farnsworth Electrical Works announce their removal on May 10th to their new building, 549-551 Mission street, between First and Second, San Francisco, where they have the largest and most modern repair shop in the West.

The Ohio Brass Company of Mansfield, Ohio, was recently awarded a contract by the Boston Elevated Railroad company for 610 automatic air connecting coupler and draft gear equipments for heavy subway and elevated train service.

The Allis-Chalmers Company have obtained the motor contract for the Glable Milling & Grain Company of Portland, Oregon. These motors vary in size from 5 h.p. to 75 h.p. The total h.p. being 400 h.p. All the motors are 440 volt, 60 cycles, three-phase.

The largest induction motor west of the Mississippi River has just been installed at the Crown Columbia Paper Mill at Camus, Washington. It is the General Electric Company's Form P. induction motor, and is rated at 1800 h.p., 2200 volts, 60 cycles, three-phase.

The General Electric Company has received an order for one ATB-2-250 kw. (625 k.a.v., .8 P. F.) 3600 r.m.m., 240 volts, horizontal Curtis steam turbine generator set, with direct connected exciter, from the Humboldt Cooperage Company of Arcata, California. This order also includes switchboard and 30 induction motors ranging from 5 to 50 h.p.

Pierson-Roeding Company has been awarded a contract for approximately one-half million feet of Orangeburg fiber conduit for underground installation of the British Columbia Electric Railway Company at Vancouver, B. C. The company has also been awarded the contract for Locke suspension insulators and aluminum wire for the new transmission line of the British Columbia Railway Company at Vancouver, B. C.

The Puget Sound Traction, Light & Power Company has just purchased from the Westinghouse Electric & Manufacturing Company one 250 k.v.a. o.i. s.c., single-phase, 60-cycle transformer for 50,000 volts, three-phase to 2300 volts, two-phase transformation, to be installed at Issaquah, Washington, also one 1000 k.v.a. o.i. w.c., 50,000 volts, three-phase to 13,800 and 2300 volts, two-phase transformer, to be installed at Everett, Wash. A 13,800 volt electrolytic lightning arrester and 2 100-ampere, 13,800 volt oil circuit breakers, swicthboards were also purchased of the same company. The company purchased in Boston, through the Stone & Webster offices 2-1000 k.v.a, o.i. w.c transformers for the Tacoma smelter substation.

The Alaska Gasineau Mining Company, through the Guggenheim Syndicate of New York, have placed an order for two 2500 h.p. water-wheel equipments for the further development of their Alaska property, and in addition to the Henry unit which they installed last year. These will be equipped with Lombard governors and latest type of automatic water economy nozzles. These units are to operate under an effective head of 653 feet. The design and construction of this apparatus was specially investigated by Mr. H. L. Wollenberg and Mr. B. Thane, manager of the property, during their recent visit to San Francisco. The entire equipment will be built by the Joshua Hendy Iron Works at their Sunnyvale shops on designs and patents of George J. Henry Jr.

The Pelton Water Wheel Company have received a contract from the Pacific Gas and Electric Company covering one 20,000 h.p. single-discharge Pelton-Francis turbine for the new installation at No. 5 development. This represents the largest wheel of this design yet built, and will be equipped with needle-type by-pass and relief valves, mechanically connected to the governor. The operating head will be 497 feet and the speed 360 r.p.m. Elaborate precautions have been taken in the design of the thrust-bearing to insure successful operation, and special balancing features will be contained in the runner chamber so that the mechanical thrust-bearing will be employed only during the period of starting up or when there is no vacuum. This machine will be built in the company's San Francisco shops.

NEWS OF ELECTRICAL CONTRACTORS.

The Potter Electric Company of Portland, Oregon, have obtained the contract for the electrical installation in the new Troy Laundry Building in Portland.

The A. Z. Smith Electric Company, 934 Commerce street, Tacoma, is installing hoisting motors and cranes for the Pacific Lumber Company, near the city.

Wm. H. Smith Electric Engineering Company of Portland, was awarded the contract for the ornamental cluster lighting in the Teviliger Boulevard Park.

The Electric Construction Company, 937 Commerce street, Tacoma, has secured the contract for wiring the Betts building, between Fifteenth and Sixteenth streets on Pacific avenue. The contract amounts to about $1500.

The Ne Page, McKenny & Company, electrical contractors and engineers of Seattle, have been awarded the contracts for installing the ornamental cluster light parts in the Peninsula Park and Washington Park, Portland, Oregon.

The Columbia Electric Company, Seattle, is wiring the Fouts apartment building, one of the finest buildings of its kind in the city. It will be equipped throughout with electric cooking apparatus. It will be conduit installation calling for lighting, heating, power telephones, etc. The company is also working on a elaborate lighting scheme for lodge rooms and assembly hall in the Knights of Columbus building at Union and Harvard streets. This will be a three color arrangement operated by a theater dimmer. Another piece of work under way is the installation of a conduit lighting system and fixtures in a store and hotel building for W. D. Morse at Port Angeles, Washington.

NEWS NOTES

INCORPORATIONS.

WENATCHEE, WASH.—Central Washington Gas Company, $100,000, by Arthur Gunn, J. H. Stout and others.

BOISE, IDAHO.—Owyhee Irigation Power Company has been incorporated for $10,000,000 for irrigation and power in southern Idaho.

SANTA FE, N. M.—John J. Jackson, representing the Portales interests, has filed incorporation papers of the Portales Power & Irrigation Company and the Portales Utilities Company. The Portales Power & Irrigation Company is a formal organization of the Westinghouse Electric Company, which is behind a big pumping irrigation project at Portales. The company is capitalized at $300,000; stockholders being H. E. Rogers, S. E. Ward, and M. V. Peasles.

SAN FRANCISCO, CAL.—Exposition Terminal Railway Company, $100,000, shares $100 each; subscribed $10,000, by J. W. Hellman, J. McNab, W. H. Crocker, H. F. Fortman, Leon Sloss and J. W. McCarthy. The object of the corporation is to operate a railway on the exposition grounds at Harbor View for the transportation of exhibits and materials from the freight ships of the exposition to the various exhibit palaces and buildings. The road is to be about ten miles long.

ILLUMINATION.

HEMET, CAL.—The Southern Sierras Power Company will submit a proposition to the board of trustees of Hemet, to install an adequate lighting system for streets.

BREMERTON, WASH.—The Bremerton-Charleston Light & Power Company has applied to the Commissioners of Kitsap county for authority to establish a line of electric poles and wire along the county roads.

SAN FRANCISCO, Cal.—An elaborate and permanent system of street illumination will be installed on Kearny street from Geary to California within the next few months, and on October 22, will be dedicated as part of the opening exercises of the Portola festival, which begins on that date.

TRANSMISSION.

NAMPA, IDAHO.—The Beaver River Power Company will apply for a franchise.

GLEADA, ORE.—Florence, Oregon, Electric Company will lay a cable across the river to furnish light to this place.

POCATELLO, IDAHO.—The Bannock County Commissioners have granted a franchise to the Utah Light & Power Company to string transmission wire along, over and under the roads of the county.

KAMLOOPS, B. C.—J. J. Carment, city clerk, will receive bids until June 12 for a hydroelectric power plant, including water wheels, generators, exciters, transformers and switching eyuipment. Plans from DuCane, Dutcher & Co., consulting engineers, 915 Rogers building, Vancouver, B. C., on deposit of $15.

VACAVILLE, CAL.—A large force of men is engaged in constructing the new power line for the Pacific Gas & Electric Company west of here. This new line will be in addition to the company's present main line, which follows the railroad track and will carry 100,000 volts instead of 60,000, the voltage of the present system.

HONOLULU, HAWAII.—The estate of C. M. Cooke, Ltd., and the J. B. Atherton Estate, Ltd., have purchased a controlling interest in the Hawaiian Electric Company. The deal involved more than $500,000, and signifies a shake-up in the affairs of the big corporation in the near future. J. A. and L. L. McCandles sold their holdings, 2388 shares, which, with the previous holdings of the two estates, gives them 4400 of the 7500 shares of stock.

OROVILLE, CAL.—A fire destroyed a substation of the Pacific Gas & Electric Company on May 12, three 60,000 volt transformers being burned out. The immediate loss will be approximately $25,000, but the indirect loss may be much larger, for absence of power has shut down all work on all gold dredgers in the Oroville field, leaving an investment of millions idle. Short-circuiting of the high tension lines at Wheatland is stated to be the cause.

STOCKTON, CAL.—The steam plant of the Oro Electric Corporation, just put in operation, is supplying light and power to several hundred farms in San Joaquin county. The current is supplied over 300 miles of distributing system built within the past few weeks, and the steam plant will supplement the service until the Oro's plant at Belden, on the Feather River, is completed. The electrical current furnished over the Oro lines is used principally for the operation of pumping plants.

BOISE, IDAHO.—The Crane Falls water power plant on Snake River, which is to furnish electric power to lift water into the Gem Irrigation District, has changed ownership, passing from Smith, Carey & Chase to the Idaho Railway & Power Company; capitalized for $20,000,000. Smith, Carey & Chase started the installation of the Crane Falls power plant some time ago. The Idaho Railway, Light & Power Company will complete the plant, making it one of the best in its system; it will have a capacity of 15,000 horsepower. Temporary arrangements are made for the delivery of power to the Gem Irrigation District through lines from Swan Falls power plant.

HOOD RIVER, ORE.—The Pacific Power & Light Co. has stopped construction work on the pipe line and power house under way here. The heavier portion of the work of the mile-long pipe line had already been completed and crews of men were constructing the foundation for the power house, where 3000 horsepower was to have been developed. It is explained by the local office that the work is discontinued because of the inability of the company to dispose of its bonds at satisfactory figures in Eastern markets. When the money market becomes better it is declared that the work will be resumed. Albert S. Hall, former local manager of the Pacific Power & Light Company, who now has charge of the Hood River Gas & Electric Company, a subsidiary concern, says that all construction work of the company in the Northwest will cease.

SAN BERNARDINO, CAL.—The fight of the Southern California Edison Company against the invasion of the Southern Sierras Power Company, continues, and the new move of the Edison company is to protest against the construction of a pole line through the city of Redlands to serve the pumping stations. The State Railroad Commission has ordered construction suspended until the commission hears the application of the Empire Water Company to issue $200,000 in bonds to develop power near the San Jacinto Mountains. At the instigation of the Edison company an injunction suit now is in the local courts, in which an effort is being made to cancel the contract the city of Redlands made with the Southern Sierras Company. The new company won the first round, the courts declining a temporary injunction pending the final decision. Recently the Sierras company won out in the Edison complaint to the State commission seeking to prevent the invasion of the

pumping field in Lytle Creek, for the commission held the the new company held a blanket franchise dating prior to the commission's jurisdiction.

MEDFORD, ORE.—With the signing of a contract between the Portland Beaver Cement Company, the recently organized $600,000 corporation and the Rogue River Public Service Corporation, successor to the Rogue River Canal Company for the latter company to supply 2000 horsepower electric power a month during the next three years for the operation of the cement plant, the fact became public that a consolidation of power sites between Grants Pass and Rogue River is nearing completion which will involve property values exceeding $5,000,000. George Sanders has the work of consolidation in charge. Irrigation rights for 56,000 acres near Grants Pass have been secured from the state, ditches are now being constructed and if present plans materialize one of the largest irrigation and electrical power corporations in the state will be the result. It is now planned to construct power dams at Gold Hill, Savage Rapids and possibly Rock Point, take over the Ament and Golden Drift dams as well as the Rogue River Chicago Irrigation Company, and put them under one operating head. Indiana capitalists are behind the deal, headed by F. M. Fauvre, W. H. English, Indianapolis millionaires. The contract for the construction of a $500,000 cement plant has been let to the Leigh Hunt Engineering Company of Kansas City with an initial capacity of 1000 barrels. J. C. Burch, the president, is now in Portland perfecting arrangements regarding details of shipping, labor supply and other matters which must be settled before actual operations can begin.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The board of trustees has passed an ordinance granting a franchise to the South San Francisco Railroad & Power Company to construct and run an electric railroad along Walker, Swift and Grand avenue.

LOS ANGELES, CAL.—The extension of the yellow car lines of Los Angeles Railway Company into Hollywood and Colegrove districts, with a view of affording improved car service, is being advocated by President Reynolds of the Board of Public Utilities.

PORTLAND, ORE.—Bolton, this side of Oregon City, on the Portland, Eugene & Eastern, will be the site of a mammoth car shop, machine shop and repair plant for the entire network of electric roads in the Portland, Eugene & Eastern system. The plant will cost upwards of $1,000,000; will cover 24 acres and be the largest carshop plant in the Northwest.

SACRAMENTO, CAL.—The Oakland, Antioch & Eastern Railway, which will soon be operating between San Francisco and Sacramento, has let equipment contracts sufficient for the first year of operation. Eight cars have been ordered from a Berkeley corporation; eight more were shipped from the East on May 1st, and another eight car order, deliverable August 1st, has been placed. Two 1800 h.p. electric motors will be here shortly, together with one express motor car, built especially for service in carrying farm produce and milk.

BOISE, IDAHO.—The Oregon Short Line has called for bids from the large electric power companies operating in the Southern Idaho field, for the furnishing of electrical power to that portion of the system it is proposed to electrify. The Great Shoshone Light & Power Company, and the Southern Idaho Light & Power Company, have submitted bids, and other companies, including the Telluride, which has power plants in the southeastern part of the state, will, it is understood, offer bids.

SAN FRANCISCO, CAL.—The Union Iron Works has delivered to the city all except one of the cars for the Geary street railway which this concern agreed to build. The other one is the car which got away at night when being conveyed to the car house and was damaged. It has been in process of reconstruction at the United Railroads car house, the restoration of it being attended to by the Union Iron Works and the United Railroads agreeing to pay the expense. The board of works and the finance committee of the supervisors have approved the payment to the Union Iron Works of $169,400, this being the contract price for twenty-two cars at $7700 each.

VISALIA, CAL.—The matter of the franchise for the Pacific Electric Company of Los Angeles through Tulare county came before the supervisors. The power company was defendant in a number of suits by southern Tulare county ranchers for erecting steel towers ten feet square at the base over the county in their desire to transmit power from the Fresno county plants to Southern California. For that reason a new route was selected. The supervisors insisted that the lines should not be strung diagonally across public highways but in spans of from 400 to 800 feet. To make an angle in the line was not desired by the company, who claimed that this would not be as safe. The matter was finally adjusted satisfactorily.

PORTLAND, ORE.—Robert E. Strahorn has resigned from the vice-presidency of the Oregon-Washington Railroad & Navigation Company and will hereafter devote his entire time to the construction of the Portland, Eugene & Eastern Interurban Electric system through the Willamette Valley. J. P. O'Brien, vice-president of the O.-W. R. & N. and general manager of the system, will take over the unfinished work in connection with the completion of the North Coast road in Washington. The resignation of Mr. Strahorn was placed in the hands of President J. D. Farrell in compliance with the recent decree of the Supreme Court of the United States which required a complete unmerging of the Harriman lines and by which no officer of any auxiliary company could be officially connected with any line in which the Union Pacific Company is interested.

TELEPHONE AND TELEGRAPH.

SOUTH PASADENA, CAL.—The Home Telephone & Telegraph Company has been granted a franchise in this city. G. B. Ocheltree, representing the telephone company, stated that as soon as the company could obtain necessary certificates of public necessity and convenience from the railroad commission, work would commence installing the necessary poles, wires, etc.

SAN FRANCISCO, CAL.—The telephone exchange planned for the Exposition will have equipment for 2000 stations and 30 operators. It will connect with all parts of the Exposition, and will be provided for long-distance service. Public booths will be scattered all over the grounds.

ANAHEIM, CAL.—The Pacific Telephone & Telegraph Company has obtained permission from the state railway commission to establish an exchange at Placentia. Construction work will begin soon as the necessary material can be placed on the site.

WATERWORKS.

OXNARD, CAL.—Sealed bids will be received up to May 27th for the construction of a municipal water plant.

BURLINGAME, CAL.—A resolution was adopted authorizing the sale of water bonds to the amount of $20,000.

BOISE, IDAHO.—One hundred thousand dollars will be spent this season by the Boise Artesian Hot & Cold Water Company in extending its system through the northwest portion of the city.

WATTS, CAL.—The board of trustees of Watts has determined that public interest and necessity demands the acquisition and construction of waterworks for supplying the city inhabitants with water. The estimated cost of said system being $85,000.

PROFESSIONAL DIRECTORY

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE—Two steel tanks, 6 ft. by 12 ft., with convex heads; sheets ½ in. and heads ⅜ in. These tanks are new and only partially built. A bargain. San Francisco Disposal Co., Evans and Keith Streets, San Francisco.

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Valle," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Edison Storage Battery Supply Co.
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Pass & Seymour, Inc.
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Converters
Wagner Electric Mfg. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Oil
Fairbanks, Morse & Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Economy Electric Co.
San Francisco, 444 Market

Edison Storage Battery Supply Co.
San Francisco, 818 Mission.

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg

Habirshaw Wire Co.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 807 Mission.
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holophane Works of G. E. Co.
San Francisco, Aranson Bldg., 3rd and Mission Sts.

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Fairbanks, Morse & Co.
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
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JOURNAL OF ELECTRICITY

POWER AND GAS

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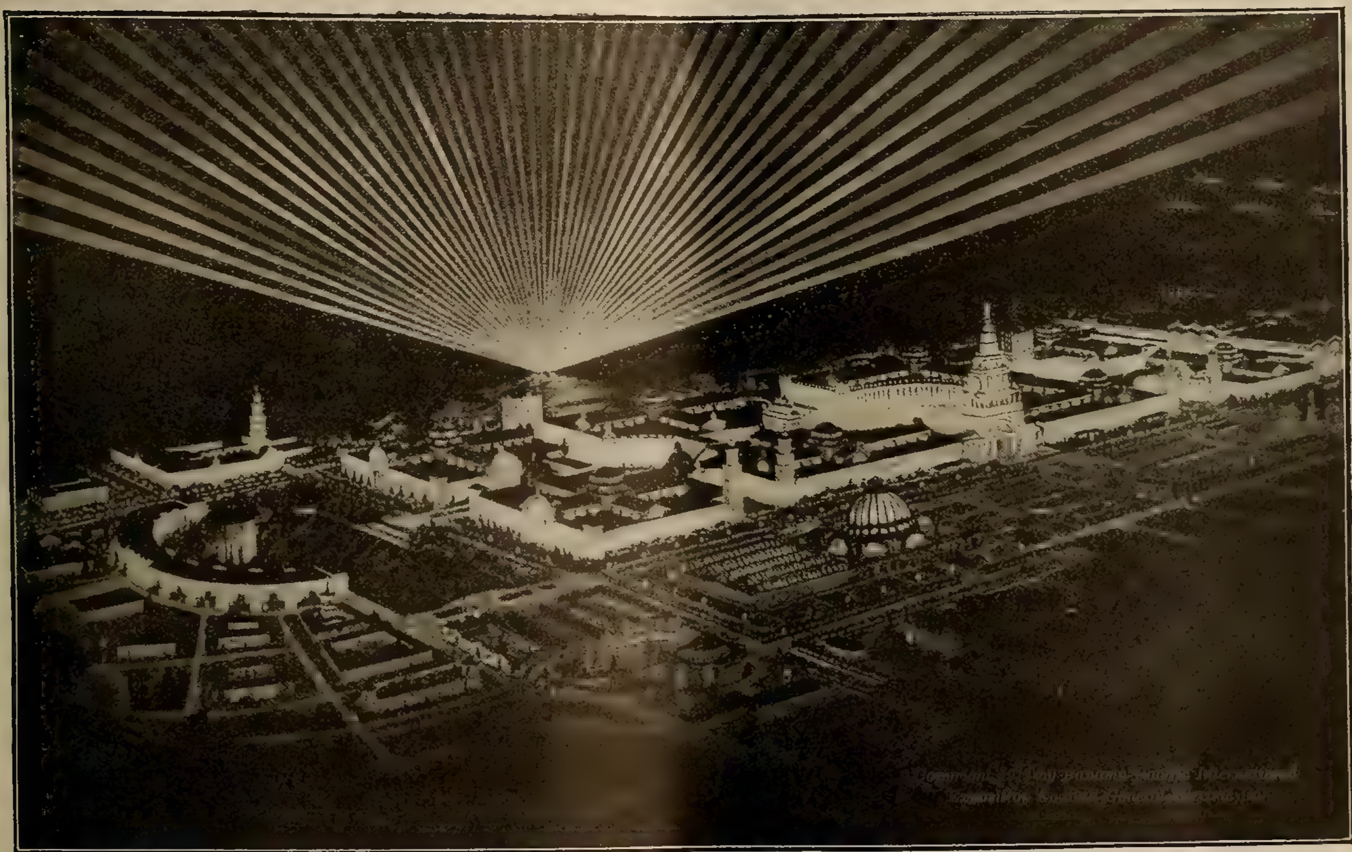
LIGHTING THE PANAMA-PACIFIC EXPOSITION



The Panama-Pacific International Exposition as It Will Appear at Night.

If the Panama-Pacific International Exposition in 1915 at San Francisco shall fittingly celebrate the opening of the Panama Canal, the lighting scheme planned for the Exposition itself will surely be commensurate with the significance and dignity of such an important event. No exposition in the history of the world has ever been lighted in the novel manner which will characterize the illumination of the Panama-Pacific. The day of the "White City" has passed. At San Francisco in 1915 The East will mingle with The West amid a wealth of color by day and a magnificance of soft blending rays by night. Practically nowhere at night will the source of light be directly visible; but everywhere will be diffused, will glow, sparkle, scintillate variegated harmonious color tones from structures studded with myriads of jewels, through pearly mists and banners radiating the delicacy of tapestry, on shimmering pools and softly tinted reflecting surfaces. The effect of the ensemble will be a vision of ever-changing color rivaling the iridescent beauty of an enchanted fairyland.

The Universal Exposition, is scheduled to open February 20 and continue until December 4, 1915; while the Panama Canal which it commemorates will be officially opened in full running order by the government on January 1 of that year. At the outset, because the Canal will afford a new trade route for the commerce of the Eastern and Western Hemispheres, the question of devising a scheme of decoration and illumination that would not only distinguish the exposition as unique among its kind but also typify in a measure the traditions of both the Orient

and the Occident, seemed of utmost importance. That the lighting effects should be designed along entirely new lines appeared imperative. The day of dazzling white expositions had been outdone. Mr. W. D'Arcy Ryan, director of the illuminating laboratory of the General Electric Company, was appointed to undertake the commission. As an illuminating engineer Mr. Ryan has already achieved national fame through his successful illumination of Niagara Falls and of the Hudson-Fulton celebration. Recently he has also devised the method for lighting the Panama Canal itself. That Mr. Ryan will meet the challenge of the world to the Directors of the Panama-Pacific Universal Exposition, "Give us something new," is exemplified and inherent in his design of the illuminating features. Here for the first time will people of all lands gaze upon an exposition which will be known and famed as "The City of Color."

"The lighting of this exposition," to quote Mr. Ryan, "will surpass anything in lighting in the world's history. The advancement since the last big exposition in the science and art of electrical engineering and the development of electric apparatus has been so great that we are now able to produce effects with economy which would have been physically impossible five or six years ago. In 1915 there will not be a single piece of lighting that has ever been used before. Everything will be new."

There will be no outlining of buildings with incandescent lamps. Outline lighting has been done about as well as it can be done. The streets of every large city today are ablaze with it, displayed in almost innumerable applications. While undeniably beautiful from a distance, outline lighting often produces contrasting glare and dark spaces; and when it comes to getting effects from mirror surfaces, such as lagoons and moats, it is sometimes impossible to secure completely the desired results. Naturally, all of these effects were considered very satisfactory not so long ago, and we caught our breath in admiration when the current was turned on yesterday's exposition; but this newest exposition is is to be wholly different in its decorative and lighting features.

While all surfaces and lights will be rich with color, there will be no glaring combinations. There will be nothing garish. The highest artistic results will be achieved with a wealth of softened tones that blend readily. The ground tone will be about the color of travertine stone, intensified by lighting to an ivory yellow which will appear almost white from a distance. Distinctive tones, so regular that they will blend in varied harmonies, Pompeiian red, strong Italian blues, vermilion and orange tones will be employed in the special color scheme. In certain colonnades the walls behind the ivory-toned pillars will be of Pompeiian red. Much of the statuary, particularly the groups, will be warm with color. The walls of many of the arcades will be adorned with huge mural paintings. The lily pools and beds of massed bloom will be encompassed by rising structures which will rival them in the beauty of color display.

The plan of the buildings is as unique as is the harmonious decorative and lighting scheme. There will be no assemblage of individual palaces separated by huge intervening areas which operate to dwarf facades however imposing. Eight of the main exhibit palaces will form parts of a correlated group surrounding the three principal courts. They will represent in connection a stupendous Oriental Bazaar, similar in form to the bazaars of the East, at Constantinople, Damascus or Cairo. All roofs of the buildings will be colored a reddish pink, like Spanish tile, and will spread out over fifty acres along the blue waters of the bay. In the setting will be patios gay with color, cornices supporting warmly tinted figures, towers and minarets pranked with red and blue and orange, and domes flashing with the yellow ochre of gold and emerald green of copper.

The official colors of the exposition are vermilion, burnt orange and a very rich Oriental blue. Thousands of flags will flutter on the buildings in the breeze from the Pacific; but they will be rivaled like the flowers, where heretofore they have had a monopoly of color. To make the flags, bunting and decorations of this kind altogether different from any other exposition, the colors have been placed in the design in alternate squares. At night, the play of the illumination will be directed so that colors will hold their absolute values.

An excellent impression of the ensemble may be gained from the words of Mr. Jules Guerin, the director of color for the exposition. "Imagine a gigantic Persian rug of soft melting tones, with brilliant splashes here and there, spread along the waterside for a mile or more, and you may get some idea of what the 'City of Color' will look like when viewed from the heights about the bay. This color plan alone will make the exposition unique among the expositions of the world."

The exposition grounds contain 625 acres in the Harbor View section, forming a natural amphitheatre overlooking San Francisco Bay and the Golden Gate entrance from the Pacific. They include part of the United States military reservations, the Presidio on one end and Fort Mason on the other. The grounds are within the city limits of San Francisco, less than two miles from the heart of the business section, extend over two miles along the water front and average one-half mile wide.

In composition the architectural plan consists of three principal elements, that of the center being the main group of exhibit palaces and the other two elements balancing on either side. To the east are the amusement concessions, while to the west lies the small city of foreign government pavilions and states buildings. The main exhibition palaces occupy over 100 acres, covering an area over 4000 feet long by 1200 feet wide. They are flanked by tropical gardens on the north and south sides, containing about 100 acres, in which the festival hall and the horticultural building will set. The foreign government and states buildings spread over about 150 acres of the government Presidio.

The majority of the main palaces are architecturally united into one enormous structure, equal in height to the average six-story city building and rising up 65, 150, 200 and 350 feet above ground, The palaces of education, fine arts, administration, varied industries, manufacture, liberal arts, machinery, mining, transportation and agriculture are approached con-

secutively like the rooms of a single colossal palace, and identified chiefly by their interior equipment as one passes through great corridors 40 ft. wide and 100 ft. high with exhibits to the right and left. Here will be seen in this main block group the most monumental expressions in Greek and Roman classic, Occidental and Oriental architecture of the most refined quality the world has ever beheld.

The central block is divided by three magnificent courts developed longitudinally north and south. Called the festival court, or court of abundance, the grand court of honor, or the court of the sun and stars, and the court of the four seasons, they are inter-connected from east to west and open in each case to the esplanade and water front. The grand court of honor in the center is the largest, approximating 500 ft. by 900 ft., and is dominated by the great tower on the south side, which rises 400 ft. into the air on the administration building and over the main entrance. Each of the two lateral courts cover approximately 300 sq. ft.

The court of the sun and stars will stand out among the most brilliant architectural expressions of the world's great expositions. It will be distinguished not alone by the majestic scale of its architecture, but by the splendor of its conception and the warmth of its color effects. The tower at the southern entrance will be studded with 50,000 jewels, diamonds, topazes, rubies and sapphires, which will sparkle at night in powerful rays from batteries of searchlights. The beauty of the changing color effects of this immense jeweled mass can scarcely be imagined. Under the play of the lights, emerald greens, turquoise blues, ruby reds and topaz yellows will iridesce with spots of color in the opposite end of the spectrum. Thus in the emerald will be seen oscillating dots of red, and similarly in the other jewels.

These jewels are not colored bulbs; they are actual jewels of the first exposition water. Great quantities are now being made from glass, of a special cutting, cut for different distances and effects, some cut in this country and others cut necessarily abroad. Strangely, glass-cutters and jewelers had never cut anything in these sizes before, and it was so entirely new to them that the illuminating engineers were obliged to figure and measure the index refraction of the glass. It will cost no more to operate the lighting with jewels than with incandescent lamps.

Not only will jewels be used for the gorgeous lighting on the imposing tower gate structure, but also wherever they can add to the beauty of an architectural line or surface or sculptured form, they will be suspended upon delicate springs so that the least vibration from the wind or machinery or even the tramping of feet may keep them in constant motion and set them flashing.

In the vaulted archways of the lofty tower arcade, 125 feet in height, through which visitors may enter the court from the south garden, will be set a series of mural paintings expressing the keynote of the exposition color scheme. The center of the court will be graced with a great sunken garden, five feet below the court level, rich with palms and shrubs and flowers. Two great fountains embracing groups of statuary, one signifying the spirit of the east and the other the spirit of the west, brought together through the Panama Canal, will also lie on the main axis within the court. At night the court will be illuminated from these fountains. They will be constructed of dense white glass, and in the daytime will in no wise suggest light sources. Within each fountain will be concealed seventy-two luminous arc lamps, a total of 144 lamps for the court. At night when lighted the entire surface of the fountain will become luminous, flooding the court with a softly diffused white light.

Perhaps the most impressive feature of the court of the sun and stars will be found in a superb classic colonnade, with columns fifty feet high, extending entirely around the court and surmounted by seraphic figures symbolical of the stars and designed to represent on one side the spirit of the Orient and on the other the spirit of the Occident. These figures, of which there will be 110, will stand fourteen feet high and the head of each will be crowned with a star measuring four feet across. The crowns will scintillate with dazzling radiance, as altogether they will be studded with some 10,000 jewels. The jewels will be lighted from the base of the figure opposite, the beams crossing the court. In the court, however, the beams will be invisible, because the white flood light which fills the court will eliminate lines of demarcation and cause the beams to vanish. In heroic groups like the one which will crown the west entrance of the main court, a group symbolizing the east and containing an elephant bearing an Indian prince in all the splendor of the Burbar, these jewels, added to the coloring of the sculpture will radiate all the sumptuous magnificence of the most vivid dream of the Orient.

Turning west the court of the four seasons will be entered from the court of the sun and stars through a huge commemorative arch, larger in size than the Arc de Triomphe at Paris. It will be surmounted by a group symbolical of western civilization. A great prairie schooner drawn by oxen will comprise the center motif of the group, typifying the advance of Anglo-Saxon civilization across the plains of America to the shores of the Pacific. To the east one will pass through a similar triumphal arch to the festive court, which will portray Oriental thought. The grouping on the arch is a colossal piece composed of camels, elephants and Oriental warriors.

All the noble facades of these magnificent palaces, the massive pieces of sculpture, softly colored, the stately pillars standing against the rich red of their Pompeiian background, the great mural paintings spread across the walls of the patios, even the blossoming reaches of the tropical gardens—all will be made visible by light scientifically chosen that will reveal their true colors in full splendor. In the courts the mural paintings will be lighted by concealed lamps set into the pillars fronting them, a special tubular lamp having been perfected for the fluted columns. The lamp and reflectors are made small enough to insert into the flute on the column. For use on smooth columns, three lamps will be inserted in each at heights of about 10, 20 and 30 ft. and partially concealed by reflectors. The illumination on paintings can be absolutely controlled in intensity and distribution by changing the size of the units and the curv-

ature of the reflecting surfaces; and by introducing colored bulbs, any color effect may be obtained.

Throughout the grounds ornamental luminous arcs will be used and fitted with dense globes, which will reduce the intrinsic brilliancy of the lamp to a point where it may be looked at directly without injury to the eye. The enclosed flame arc lamp is well suited for lighting large inside areas and will be used extensively for indoor lighting, the interior of the buildings being tinted a pearly tone. Both the ornamental luminous and flame arc lamps with heavy diffusing globes will give nearly four times as much light for an equal amount of power as the older types of carbon arc lamps used in previous expositions.

Deep in the lagoons and artistically chosen waterspaces will appear perfect and complete reflections of the brilliant walls and towers of the exposition, not striped with lines of light on areas of shadow but glowing in all the radiant colors and contrasting surfaces which the architect, sculptor and colorist have created for them. And high upon the roofs and towers of the great buildings the symbolical banners and flags will not be lost against the night sky but will be brought out in full value. Extending along the outside of the walks in front of the main exhibition palaces for a distance of nearly two and one-half miles will be placed singly and in groups standards on which will be suspended large banners representing Spanish heraldry in design. They will be made in the exposition colors and three shields will be mounted on each standard. Back of them will be concealed five luminous arc lamps in each case reflecting on the buildings. The banners are being so constructed that the light glowing through them will present from the court drives the marvelously realistic effect of tapestry.

There will be electric fountains, but no water will flash in them. Instead, smoke and steam, much superior media for such effects, will be sent into the air and glow with tints from the rays of the mighty scintillator. A huge locomotive, which can develop enough power to drive it along at eighty miles an hour, will be mounted on a steel turntable and will belch forth against the sky great columns of smoke and steam through which the rays of the scintillator will play. Contrasting delicately with these geysers of color, provided experiments now being made prove successful, thousands of gigantic soap-bubbles will be released from a large blower and float into the air. On these the powerful rays of the scintillator will glisten with the iridescence of an insect's wings. Quantities of cloth balls specially constructed for the purpose will be sent soaring into the air on festive nights and will glow with ever-changing color combinations in the widely projected beams of tinted light.

At the western end of the massed assemblage of exhibit places will be seen the classic outlines of the Palace of Fine Arts, a beautiful example of Italian architecture fronted with a great spacious semi-circular court resembling St. Peter's at Rome. At night its ivory colonnades, drenched in silver radiance apparently from the moon, will be reflected on the surface of the dreamy lagoon in the intervening space between the palace and the main block of buildings. But perhaps the most gorgeous effects of glittering reflection will be realized in the horticultural palace at the left when entering through the southern gardens. Composed most entirely of glass, it will be a veritable crystal palace and at night will rise like a gigantic shimmering bubble of light 165 ft above a fairyland of illuminated blossoms and shining fountains.

The mammoth electric scintillator, which will be anchored on barges in the bay 500 to 600 yds. from the shore, will project out over the entire grounds great beams of colored light variations aggregating over 4,000,000,000 candlepower. This will consist of a battery of forty-eight searchlights having 36-inch parabolic mirrors and representing the forty-eight states. Sixty men will be required to operate the lights and will be trained to direct them through many evolutions of color, throwing brilliant auroras into the sky. On clear nights the spread of these colors will be visible in all the bay cities to a distance of fifty or sixty miles. But mists often roll in from the bay at night, which will greatly heighten the wonderful lighting effects, furnishing a background upon which to play the constantly changing color scheme, and to soften and intensify the lights at will.

That the exposition in its entirety will be made not only a beautiful vision but will leave a lasting impression of its greatness and grandeur on the many thousands of visitors both from this country and abroad is assured. It will be a fitting and adequate expression of the opening of the new gateway to the east and the west. But the impression of newness in expositions, a prominent difference that will charm and linger long with the visitor, will be the combined decorative and lighting scheme, a modern aesthetic achievement, a new "Symphony in Color."

ELECTRIC PLANTS AND TELEPHONES IN CENTRAL CHINA.

BY CONSUL-GENERAL ROGERS, GREENE, HANKOW.

There are three electric light plants at Hankow, one for the Chinese city and two, one of them very small, in the foreign concessions. There is a telephone service operated by the German postoffice in the foreign concessions and a Chinese telephone service in the native city. The Chinese telephone service connects wtih the neighboring cities of Wuchang and Hanyang.

In Wuchang there is a small electric plant, mostly for official use, but I understand that a municipal system is contemplated.

In Changsha, the capital of Hunan Province, there is a fair electric light plant, and there is also a telephone system, though the latter is used by private persons.

In Kiukiang there is no electric light plant. In Nanchang there is a small electric light plant. In both cities there are telephones, but no system that is in general use with any considerable number of subscribers.

It would be exceedingly difficult, if not impossible, for a foreign company to get any public service franchise, and the number of Chinese merchants with whom a joint Chinese-foreign enterprise could be conducted is still very small.

GAS ENGINEERING

DISTRIBUTION OF GAS.—III.

(Concluded)

BY E. C. JONES.

In laying new mains for gas the pipes are of necessity filled with air. This air must be expelled before the main is placed in use. The safest and most economical way to displace the air is to provide a large outlet and open the full pressure of gas on the initial end of the new main. In this way the air is expelled quickly, and the body of air moves in front of the advancing gas with very little mixing of the two.

Matches and open lights should never be used for testing mains or services, and the sense of smell is unreliable. A simple test for determining when the air is entirely displaced by gas in mains, holders, or other new gas apparatus, is made by taking a sample of the mixture in a rubber gas bag. The tube of this bag is then held beneath the surface of a pail full of soap and water, and a portion of the gas mixture is squeezed out of the rubber bag into the soapy water. Bubbles form on the surface of the liquid, and these bubbles may be tested by a lighted match. If there is little gas in the mixture the match will be extinguished, and as the proportion of gas increases the gas and air will explode with increasing and then diminishing activity until the bubbles filled with pure gas will burn slowly with a yellow flame. This is an interesting experiment, but care is necessary to test the samples taken in the rubber bag at a safe distance, and preferably to windward of the main or other apparatus under test, and the tube of the rubber bag should never be lighted. The soap bubbles contain enough of the gaseous mixture for a satisfactory test without danger.

There are three critical points in mixtures of gas and air; when the mixture begins to be explosive; when it is most explosive; and when the mixture burns without explosion.

Oil gas of the following composition

$$
\begin{aligned}
CO_2 &= 1.6\% \\
C_nH_{2n} &= 6.8\% \\
O_2 &= 0.2\% \\
CO &= 3.4\% \\
H_2 &= 52.1\% \\
CH_4 &= 30.8\% \\
N_2 &= 5.1\% \\
\hline
& 100.0\%
\end{aligned}
$$

begins to explode in proportions of 7 parts of gas and 93 parts of air. It is most explosive when the proportions are 15.4 parts of gas and 84.6 parts of air, and the mixture begins to burn without explosion when the proportion is 24.5 parts of gas and 75.5 parts of air.

The increasing popularity of gas, and the large demands on existing low pressure systems, created a condition which required the laying of larger mains or materially increasing the pressure.

A new installation would be expensive and increasing the initial pressure would cause a portion of the district to suffer from excessive pressure in order to supply the consumers at distant points with needed pressure.

Distribution of gas under high pressure was the invention born of this necessity, and by its use low pressure systems which were becoming inadequate have been made amply large, and the benefits of gas supply have been extended to suburban and interurban districts that could never hope for gas service under low pressure conditions. High pressure gas means gas compressed and delivered under pounds per sq. in. instead of inches in water pressure.

The gas men of California did pioneer work in high pressure gas distribution, and the first installation was in Oakland by Mr. John A. Britton, in 1885. This line was for the supply of gas to Alameda, and the pressure carried was up to ten pounds.

The first extensive use of high pressure gas in California was a line of 2 in. steel pipe 16.8 miles long between Santa Rosa and Petaluma. This line was laid in 1902, and for years the city of Petaluma has been supplied with gas depending entirely on this small pipe. There is no gas works in Petaluma, and until quite recently there was no storage holder. The initial pressure was varied according to the demand for gas up to a maximum of 100 pounds.

The first line was laid with standard 2 in. pipe using ordinary couplings for joints, but this was displaced by the present line consisting of steel casing 2 in. outside diameter joined by couplings consisting of a metal sleeve, and two flanges drawn together with bolts and using rubber gaskets between the sleeve and flanges to make gas tight joints. These coupling joints are generally used on high pressure mains, and have proven satisfactory on natural gas lines, but illuminating gas contains enough benzole (which is a solvent of rubber) to attack the rubber gaskets and cause leaks of gas. Dipping the gaskets in a solution of shellac in alcohol and coating the sleeves and flanges with the solution stayed the destruction of the rubber, but this added to the already large expense for a joint that was not entirely satisfactory caused the search for a better way to join tubes.

Again the need was satisfied by a timely invention. The work of welding metals by the oxyacetylene torch had been perfected to a degree which warranted trying it on high pressure gas lines, and during the year 1912 an 8 in. O.D. line of steel tubing about a mile in length was laid in San Francisco with welded joints. At first the welding was slow and required skilled workmen, but in less than a year all obstacles have been surmounted, and welded tubes are now accepted as the quickest, cheapest, and best joint. The work is now done by a portable welding set mounted on a special automobile and the regular main layers do the welding.

In welding 8 in. O.D. casing, which is .185 in. thick, each joint requires 9.25 ft. of acetylene and 16 2/3 ft. of oxygen. At present prices the acetylene for an 8 in. joint costs 18½ cents, oxygen 41 2/3 cents,

and labor, including welding, handling of pipe, and painting, costs 23 cents, making a total cost of 83 1/16 cents per joint. This is less than half the cost of a coupling joint with rubber gaskets, and is gradually being reduced as experience is gained in welding.

The first 8 in. welded joints cost $2.50 each. These were made by acetylene generated from calcium carbide on the work while the acetylene is now furnished in portable tanks containing 500 cu. ft. each.

Heavy and expensive high pressure fittings have now been displaced by welding together steel tubes of any sizes into T's, Y's, or other shapes as needed. These eliminate cast iron from high pressure lines, and they are strong and gas tight. Coincident with the first welding of tubes the mills began the manufacture of tube lengths 40 ft. long, this reduced the number of joints by half as the tubes previously made averaged 20 ft. in length.

Services from high pressure mains need not be so large as low pressure services. Pipes of ½ or ¾ in. diameter are sufficiently large for ordinary consumers. These services are connected to a steel main by means of a clamp saddle over a lead washer. This saddle is fastened to the main by two iron threaded yokes passing under the main and through the saddle, holding it in place, gas tight by nuts. A stopcock is then screwed into the saddle and with the stopcock open, a hole is drilled through the main, the drill passing through the opening in the barrel of the stopcock. After removing the drill the stopcock is closed and the service pipe is run in the usual manner. In this way high pressure connections are made to mains under pressure with very little loss of gas. Each service is provided with a high pressure regulator, which reduces the pressure before the gas reaches the meter to about four inches of water. This is perfect gas service, because the great excess of pressure in the main keeps a constant supply of gas at uniform pressure on the house pipes, no matter how erratic the use of gas may be.

The regulators are dependable and seldom fail to act. The only precaution necessary is to provide a safety tube connected to the top of the regulator and passing out of doors. This is to vent a defective regulator, and avoids the effects of high pressure on the meter and gas fixtures.

High pressure mains are used to re-inforce low pressure systems, either by running spines of high pressure mains through the district or preferably by surrounding the low pressure system by a high pressure loop. This last method was recently applied to San Francisco. A 16 in. O.D. steel tube was laid from the Potrero Gas Works on the south, around the city to the storage holders at North Beach. A pressure of 30 pounds is now carried on this loop, and connections are made between the loop and the low-pressure mains at points where the pressure is low or the demand for gas is great, through district governors which automatically discharge gas at any desired pressure into the low-pressure mains. This 16-inch high-pressure main has its terminal in the grounds of the Panama-Pacific International Exposition, and insures an ample supply of gas and excellent service to meet the gas requirements of the World's Fair in 1915.

The pressure is raised and maintained in high-pressure mains by single or double stage gas compressors. Single stage compression is economical for pressure below 80 pounds per square inch, and for higher pressure multiple stages are used, with intercoolers for taking away the heat caused by compression.

The compressors used are either steam-driven or are belted to steam or gas engines or electric motors. Steam used as motive power has the advantage of variable speed adaptable to varying loads, but when ever possible gas engines should be used with compressors having suitable unloading devices which compensate for varying loads.

The gas manufacturer should use his own product for every conceivable purpose, as it establishes confidence in the merits of gas and is the best form of advertising. The effects of compression on gas is to squeeze out the water and some of the unstable hydrocarbons contained in the gas. The relative humidity of gas in a gas-holder is practically the same as that of the atmosphere, and as gas is compressed the water vapor contained in it is condensed as water, until at high pressure the gas is completely dehydrated.

Provision must be made to care for the water and condensed hydrocarbons and prevent them from flowing into the mains. For this purpose compression tanks usually 6 ft. in diameter and 30 ft. long are interposed between the compressor and the main. These tanks trap the compression liquid, and it may be removed by opening a tap, and the gas pressure in the tank blows it out. It will thus be seen that no pumping is necessary on high-pressure drips as the pressure of the gas forces out the liquids.

The following table shows the physical changes which take place in oil gas when subjected to high pressure:

THE EFFECTS OF HIGH PRESSURE
UPON
ILLUMINATING GAS.

Pounds Pressure	C_nH_{2n}	CH_4	H_2	CO	CO_2	O_2	N_2	Specific Gravity	B.T.U.	Candle Power	Remarks
	%	%	%	%	%	%	%				
0	7.0	29.7	50.0	5.2	3.0	Tr.	5.1	.413	626	21.6	H_2S=200 Gr.
30	6.8	29.8	50.1	5.4	2.8	Tr	5.1	.411	625	20.0	
60	6.8	29.6	50.2	5.5	3.1	0.1	4.7	.412	624	17.0	
90	6.8	29.6	50.3	5.5	3.1	Tr.	4.7	.411	624	16.0	
120	6.7	29.5	49.2	5.6	3.2	0.1	5.7	.422	618	15.0	
150	6.7	28.8	51.3	5.5	3.3	0.1	4.3	.407	617	14.0	
180	6.5	29.0	51.0	5.5	3.0	Tr.	5.0	407	615	11.1	
210	6.0	29.0	51.0	5.7	3.2	0.1	5.0	408	607	9.6	
240	6.3	29.0	51.0	5.4	3.2	0.1	5.0	.408	611	10.8	
270	6.0	29.1	51.6	5.5	3.2	0.1	4.5	.403	610	6.2	
300	5.7	30.0	51.4	5.6	3.0	0.1	4.2	.399	614	5.5	H_2S-None

E C JONES

In making these experiments it was discovered that compression of gas besides removing the water vapor, causes a continuous reduction of candle power, due to the squeezing out of the benzole contained in the gas. And if the pressure is raised to 300 pounds

there is a total elimination of naphthalene and sulphuretted hydrogen. It is thus possible to dispense with purification of gas if it is compressed to 300 pounds, as compression performs all the functions of the purifiers as well as removing naphthalene and water vapor. At 120 pounds pressure the sulphuretted hydrogen was reduced from 200 grains to 70 grains per 100 cu. ft of gas.

The compression liquid flows with the gas into the compression tanks, and if the gas which has lost some of its candle power during compression is permitted to come into slow contact with the compression liquid, it will absorb enough of the benzole to restore its candle power, but it will not take up any of the condensed naphthalene or sulphuretted hydrogen.

High pressure gas distribution has many advantages over low pressure, inasmuch as there are no stoppages caused by naphthalene or condensed water, and the manner of laying the mains and the severe tests to which they are subjected before being used makes them practically gas-tight and reduces the loss by leakage.

Satisfactory distribution of gas is fully as important as the quality of the gas supplied. Piping that is too small or badly drained, and low or uneven pressure is often called poor gas, and it is difficult to convince a consumer as to the cause of the complaint. Good service is the result of well-balanced distribution, and the chief aim of every gas company today is to furnish perfect service to the consumers.

MACHINERY EXHIBITS AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

Rapid progress is being made in the construction of the main exhibit buildings at the Panama-Pacific International Exposition at San Francisco. The first of the buildings is now completed, and five other structures are under way. There will be fourteen main exhibit buildings all told, and contracts will be let upon the remainder to bring all to completion by July, 1914. Work upon the Machinery building, the largest of the exhibit group, was begun early in the year, and the framing of the main portion of the structure is partly completed. This will permit the complete installation of exhibits by the opening date, February 20, 1915. The Exposition management plans a record not only in construction, but by presenting a finished spectacle on the opening day.

The department of machinery exhibits is thoroughly organized, and filings for exhibit space have been received to an extent that assures a display commensurate with the importance of the industry. Early applications are especially welcomed by the Panama-Pacific management, and will facilitate the proper grouping of the exhibits and the perfection of other arrangements essential to the interests of exhibitors as well as to the Exposition.

For the information of the exhibitors the following brief data has been issued by the Exposition company:

The Machinery building will have nearly eight acres of floor space. In addition there will be an auxiliary structure to be known as the Gas and Fuels building. Electrical machinery, instead of being placed in a separate building, will be located in the Machinery building and classed under the general heading of machinery. All parts of the building will be served by adequate crane facilities. Electric current, alternating and direct, gas and water, will be available in any portion of the building; compressed air and steam will be provided in a section adjacent to the Gas and Fuels building. General illumination is to be provided by the Exposition company, but a nominal charge will be made to exhibitors for other utilities service they desire. Special rates for power will be made to exhibitors who use it to show machinery in motion.

The floor of the Machinery building is designed for a load of 200 pounds per square foot. The soil conditions will permit adequate foundations for heavy machinery to be readily constructed. No charge will be made for space.

The management urges that concerns and individuals desiring to participate lose no time in getting into touch with the Exposition company and filing applications for space.

Copies of the rules and regulations, documents as to the classification of exhibits, blank applications for space and other information prepared for the guidance of exhibitors will be promptly forwarded on request to the Panama-Pacific International Exposition Company, San Francisco.

"OLD SOL WORKING OVERTIME."

While the business man who is seized with fright every time he hears the tariff discussed, while the banker is complaining that we haven't a currency sufficiently elastic, and while the average citizen feels a mood of economy stealing over him, nature seems unperturbed and is working overtime to shower blessings on all sides. Old Sol is blessing Mother Earth with his rich and warm rays in a sacrificial effort to give us a bountiful harvest this fall, and thereby arouse frail human nature from its pronounced case of dejection and the pip.

They may cut the tariff if they wish to, they may give the nation a better currency system, but no congress can stop old Sol from making the earth give forth an unusual bounty of riches in the form of bumper crops.

The first crop report published this week is a real tonic for whatever depression envelops us now. It is out of the earth the new wealth comes each year, wealth that must be moved and consumed. If nature's moods do not go awry before the harvest we may confidently look for new yields which will exceed Hill's great dream of $9,000,000,000.

Imagine what this wealth means to commerce of this country. Think what it represents to the prosperity of the nation.

It will be crops, nothing else, which will prove the saving situation for this country next fall. We may then have so much money as to become even indiscreet enough to buy automobiles. And the soup houses about which we hear the croakers talk so much will again fade away as a mere memory of 1893.—The Financial World.

ELECTRICAL PUMPING AND IRRIGATION

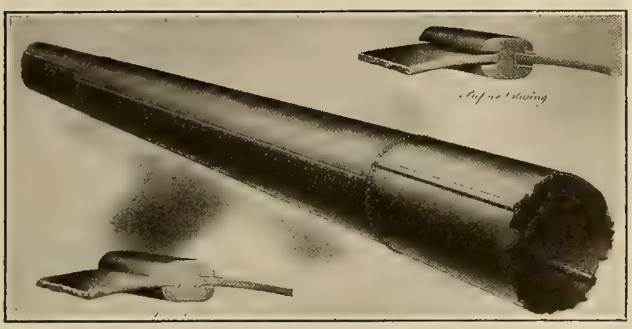
PRESSURE PIPES FOR THE CONVEYANCE OF WATER AND FOR INVERTED SIPHONS.

BY B. A. ETCHEVERRY.

Pipes are used for irrigation as pressure pipes to cross depressions in the form of inverted siphons, and for the distribution of water as described later. For irrigation purposes pressure pipes are made of wooden staves, steel, and reinforced concrete. Plain concrete pipes are used only for low pressures. Cast iron pipes are seldom used because of their high cost in the West and of difficulties of transportation. Steel or iron pipe is not as durable as cast iron pipe but is much lighter, which is an advantage as regards transportation and cost. For pressures under 200 ft. wooden stave pipes are usually more economical and for pressures under 100 ft. reinforced concrete pipe will often be more economical because of its durability.

Steel and Iron Pipes.

Steel and iron pipes are made in sections of sheets usually joined by riveting, welding, etc. Riveted pipes may be spirally riveted, longitudinally lap riveted or butt riveted. A type of steel pipe originated in Australia, has a very efficient type of joint. The joint is a lock joint formed by upsetting the plates slightly at the edges, inserting these longitudinal edges in the grooves of a double grooved locking bar, and closing the grooves by hydraulic press. The joints to connect the sections may be riveted, slip, flange or bolted expansion joints. The thickness of the pipe must be sufficient to not only resist the tensile stress but must be made thick enough for stiffness and to allow for rusting.



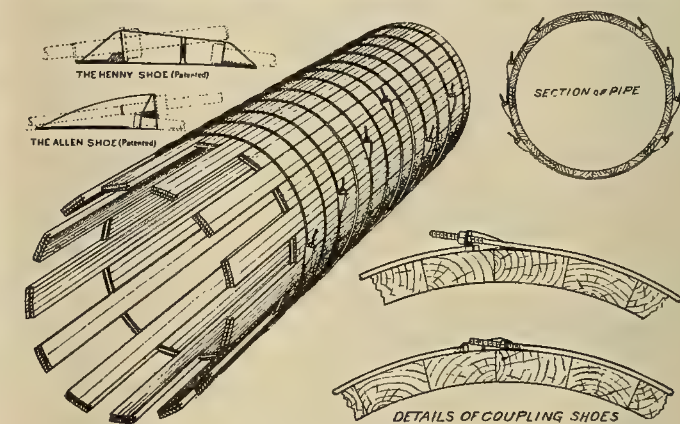
Steel Pipe With Lock Joint.

If S = allowable stress per square inch.
- p = total pressure per sq. in., allowing for water hammer.
- r = radius of pipe in inches.
- t = thickness of pipe in inches.
- e = efficiency of joint (60 to 70 per cent for double riveted pipe, 100 per cent for lockbar pipe.)

$$\text{then } t = \frac{1}{e}\,\frac{pr}{S} + \frac{1}{16}$$

Wooden Stave Pipe.

This pipe consists of staves formed with radial edges and bound tightly together by means of round or oval bands of steel or iron spaced and sized according to the pressure. The pipes may be made continuous and built on the ground or may be made in sections at the factory. The bands for continuous pipe are hoops fastened at the ends by shoes and nuts which permit tightening of the bands. The bands for the pipe built in sections consist of wire wound in a spiral. Two independent spirals are sometimes used. This is preferable, for should one wire break the pipe will be held together. The staves for the continuous pipe usually break joints and are joined at the ends by inserting a metal tongue. The staves are made of clear wood, either of California redwood or Oregon fir. The size of the staves varies from 1 x 4 in. to 2½ x 8 in. The pipe built continuously is generally used for large size pipes above 24 in. in diameter up to 120 in. The wire wound section pipe is manufactured in sizes from 2 to 24 in. One end of the section is made beveled and the other end is surrounded with a wire wound wooden collar which forms a bell. The wire is generally galvanized steel. Very sharp curves are made by using cast iron elbows with bell ends. For curves of greater radius the wire wound short sections are made. For continuous pipe the staves can be sprung to fit the curve when the radius of curvature is greater than 200 or 300 ft. Connections and gate valves are made of cast iron fittings with bell ends and the joints are made with oakum and lead. Small fittings, such as air valves or small wrought iron pipe takeouts, can be screwed directly in the staves.



Wood Stave Pipe.

Design of Staves and Bands.

The principles on which the design is based are the following:

1. The staves must be thin enough to secure complete saturation and to deflect readily to the degree of curvature employed. They must be thick enough to prevent undesirable percolation.

2. The bands must be of such size and so spaced that the bands will resist all strains coming on them and not crush the fiber beneath them. The spacing must not exceed a certain maximum. For staves made of 2 in. lumber the maxium spacing adopted is from

10 to 12 in., varying with the diameter of the pipe. For staves made of 1½ in. lumber the maximum spacing is 10 in. The bands must resist (a) the stress due to water pressure, (b) the stress necessary to give a degree of compression per sq. in. between the staves in excess of the water pressure, and (c) the stress due to swelling of the staves.

The size of the band and the spacing are related. When properly designed bands should be of such size and so spaced that the band will be strained to its safe resisting value and the bearing pressure on the stave will be equal to the safe bearing value of the wood. When not properly designed the spacing may be correct for the strain on the band but may produce an excessive bearing force on the stave. On the other hand the band may be designed for correct bearing pressure but the spacing may cause excessive strain on the band. The equations expressing these relations for the correct design are obtained as follows:

Let R = internal radius of pipe in inches.
r = radius of band.
f = spacing of bands.
P = water pressure in pounds per sq. in.
S = safe strength of band $= \pi r^2 S$.
E = swelling force of wood per sq. in. between staves.
t = thickness of stave.
s = safe tensile strength per sq. in. of band steel.
e = safe bearing power of the wood per lineal inch of band.

Size of Bands.

For a pipe of a given diameter there is corresponding correct size of band to use; this band is the one which when strained to its safe strength will sink sufficiently into the stave to produce a bearing pressure equal to the safe crushing strength of the wood. The bands will sink into the wood depending on the stress in the band. The width of contact before the fibres are crushed beyond safety has been found to be about equal to the radius of the band. The ultimate crushing strength of wood is from 1000 to 2000. The safe stress is usually taken as 650. The stress in the band corresponding to the bearing pressure e or 650 r is $S' = (R + t)\, e = (R + t)\, 650\, r$.

S' should be equal to the safe strength of the band which is equal to $\pi r^2 s$.

$$\text{Therefore } (\pi r^2)\, s = (R + t)\, 650\, r;\ r = \frac{(R + t)\, 650}{\pi s}$$

The ultimate strength per sq. in. of steel is about 60,000 pounds, assuming a factor of safety of 4 the safe strength is 15,000 pounds per sq. in. of band cross section. For this value of s $r = .0138\ (R + t)$.

Spacing of the Bands.

The forces which the bands must resist are:

1. The water pressure which causes a stress on the band equal to PRf.

2. The swelling of the staves which causes a stress on the band equal to ftE.

3. The necessary compression between the staves to prevent leakage at the joints. The compression between the staves must be greater than the water pressure or water will be forced out at the joints. The swelling of the staves will produce some compression, but an initial compression is necessary to supplement the swelling compression and to act when the pipe is first used before the swelling of the staves. Assume that this initial unit compression is made 3/2 of the unit water pressure; then the stress produced on the band is 3/2 Pft.

Economic Proportions for Stave-Pipe Design (By Arthur L. Adams.)

Nominal diameter of pipe inches.	Stock sizes for staves in inches.	Thickness of finished staves inches.	Oval. Economic sizes of bands, inches.	Working stress in band S. Pounds.	Factor of safety in band.
10	1 1/2x4	1 1/16	5/16x7/16	1255	5.26
12	1 1/2x4	1 1/8	5/16x7/16	1475	4.47
14	1 1/2x4	1 3/16	5/16x7/16	1650	4
16	2 x6	1 7/32	5/16x7/16	1650	4
18	2 x6	1 3/8	5/16x7/16	1650	4
20	2 x6	1 3/8	5/16x7/16	1650	4
			Circular.		
22	2 x6	1 3/8	3/8	1508	4.4
24	2 x6	1 3/8	3/8	1650	4
27	2 x6	1 7/16	3/8	1650	4
30	2 x6	1 1/2	1/2	2673	4.4
36	2 x6	1 9/16	1/2	2950	4
42	2 x6	1 5/8	1/2	2950	4
48	2 x6	1 11/16	1/2	2950	4
54	2 1/2x8	2 1/8	5/8	4600	4
60	3 x8	2 1/2	5/8	4600	4
66	3 x8	2 9/16	3/4	6600	4
72	3 x8	2 5/8	3/4	6600	4

The spacing of the bands must be such that the total stress due to these three forces is equal to the safe strength of the band (or the stress on the band corresponding to the safe bearing pressure of the band on the staves). Therefore,

$$S = \pi r^2 s = PRf + ftE + ft\frac{3}{2}P \text{ or } f = \frac{S}{PR + tE + \frac{3}{2}tP}$$

E is commonly assumed to be equal to 100. Usually either the swelling force of the stave or the initial compression is neglected. The equation then becomes:

$$f = \frac{S}{PR + 100t};\ \text{or } f = \frac{S}{PR + \frac{3}{2}tP} = \frac{S}{P\left(+\frac{3}{2}t\right)}$$

For large size pipes and high heads the terms 100 t and 3/2 t are relatively small and the equation may be written: $f = S/PR$. S is obtained from the above table.

Advantages of Wooden Stave Pipe.

1. It is cheaper than steel pipe.

2. Except for the bands it is not subject to corrosion and the bands can be well coated with asphalt.

3. It has a greater carrying capacity than a riveted steel pipe of the same diameter. The coefficients of roughness for use in Kutter's formulae are, for clean riveted pipe .015 and for wooden stave pipe .012.

4. When kept well saturated its durability is probably greater than that of steel pipe.

5. It is not affected by the heat, while steel pipe requires to be laid in a trench and covered or will need to be anchored or expansion joints provided.

6. It is not affected by cold and will probably not be damaged should the water in it freeze solid.

Disadvantages.

1. If not kept saturated its life is very much shortened.

2. Unless laid in a trench and covered it is liable to destruction by fires.

LOCATING FAULTS IN UNDERGROUND CABLES

THE VARLEY LOOP—III.

BY C. A. GAINES.

By introducing a known resistance in series with the cable in the Murray loop test we have the connections for the Varley loop. The common Wheatstone bridge set, in which the terminal of the battery, usually attached at "C." can be removed and connected to one of the cable conductors, or to the ground, as the case may require, is more satisfactory for this test than the slide wire bridge. Let "A" and "B" be the two ratio arms of the bridge, "R" the adjustable re-

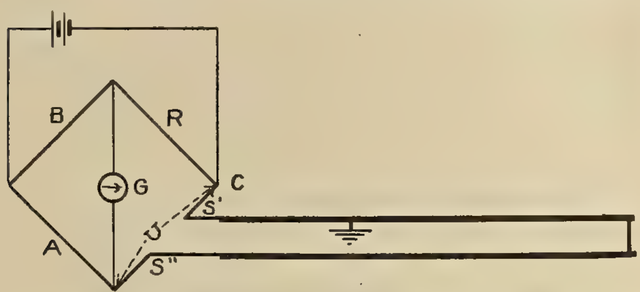


Fig. 1. Measuring Resistance of Loop "U."

sistance "X" the resistance to fault, S′ and S″ the resistance of the two leads, and "L" the length of the cable in feet. Using the bridge with battery connected to "C," as in Fig. 1, the resistance "U" of the cable loop and connecting leads is first obtained by the equation $U = AR/B$.

Switching the battery terminal from "C" to the ground, as in Fig. 2, we obtain a balance by adjusting the different arms of the bridge until there is no deflection of the instrument needle.

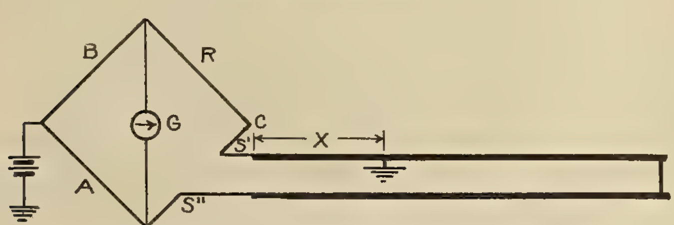


Fig. 2. Measuring Resistance of Cable to the Fault.

Then, $X = \dfrac{BU - AR}{A + B} - S'$ in which X is the resistance of the faulty conductor from station to fault.

It now remains to obtain the resistance of the entire length of the faulty conductor, which we will call "W." With two good wires this can easily be

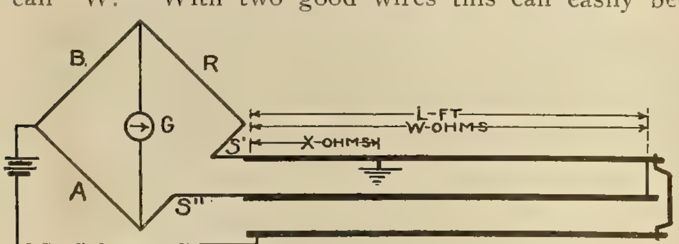


Fig. 3. Measuring Resistance of Entire Faulty Conductor.

done by a further application of the Varley loop principle, in which the second good wire is used for one of the battery leads, as in Fig. 3, and when a balance is obtained.

$$W = \frac{BU - AR}{A + B} - S'$$

After obtaining both "X" and "W" the distance to the fault in feet is

$$\frac{X}{W} L$$

As an example of the use of the Varley loop method of testing, we will consider an actual case which came under the writer's observation. The resistance of the lead S′ was found to be .018 ohms and the resistance of the loop "U" to be .215 ohms. In determining the resistance of the faulty conductor from the station to the opposite end a balance was obtained with

$A = 10$ $B = 1000$ $R = 11$

$$W = \frac{BU - AR}{A + B} - S' = \frac{.215 - 110}{1010} - .018 = .086 \text{ ohms.}$$

In finding the resistance to the fault the values when a balance was obtained were:

$A = 10$ $B = 1000$ and $R = 14$

"X" is therefore .056 ohms.

From the map records we learned that the particular piece of cable under test was 1650 ft. long.

The fault must then be $\dfrac{.056}{.086} \times 1650$ or 1070 ft. from the testing station. This came between two manholes, in each of which we cut the cable and then replaced the defective length between the two holes.

An ammeter and voltmeter can be used to locate a fault by connecting as shown in Fig. 4. The current is first sent over the entire length of the faulty conductor and the drop in volts "W" read from the volt-

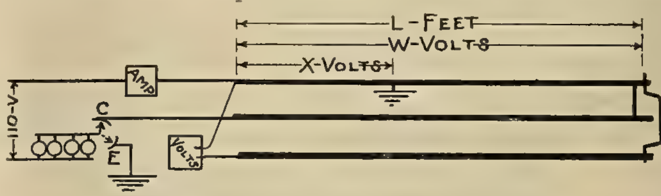


Fig. 4. Voltmeter and Ammeter Method.

meter. Next by changing contact from "C" to "E" we send the current over the faulty conductor as far as the fault, and the drop over this portion of the cable is read from the voltmeter. Call this drop "X." Then if the current through the ammeter has been kept at the same value in both tests the distance to the fault in feet is equal to XL/W.

If the two ammeter readings cannot be made equal and "A" is the current when the drop "W" was obtained, and A_2 the current when X was obtained, then

W/A_1, equals the resistance of the entire conductor and X/A_2 equals the resistance to the fault, then

$$\frac{A_1\ XL}{A_2\ \ W}$$ is the distance to the fault.

A very convenient set of tables can be made giving the length of the different cables with the distance from each end to every manhole where the cable appears. These distances are also given in per cent of the total length to simplify the calculations with the slide wire bridge. The following is a portion of one of these table.

Power House Cable No. 10; Length 14532 Ft.; Size No. 2/0.

M. H. No.	Location.	L&—A	%—L	L″—I	%—L
5147	Sta. "A"	301	2.1	14231	97.9
5146	Bet. Mich. & Geo. Illinois.	560	3.9	13972	96.1
5146	Bet. 22d & 23d.	959	6.6	13573	93.4
5144	Illinois	1421	9.3	13111	90.2
5143	Kentucky Kentucky.	1674	11.5	12858	88.5
5142	1-N-22d	2079	14.3	12453	85.7
5141	2-N-22d	2481	17.1	12051	82.9
5140	1-N-20th	2885	19.9	11647	80.1
5139	1-N-19th	3285	22.6	11246	77.4
5138	1-N-18th	3642	25.1	10890	74.9

GROUNDING OF SECONDARY CIRCUITS.

The National Electric Code Edition of 1913, will make grounding of transformer secondaries mandatory, consequently some of the standard methods employed by power companies will be of interest. The Central Colorado Power Company has been grounding secondaries with good results for several years under the following instruction to consumers:

230 volts. On the 230 volt circuit the potentials to ground are respectively 0, 230 and 230.

In Fig. IV, the potentials to ground on the lighting circuit with the ground connected at a are respectively 0, 115 and 115 volts.

With the ground connected at b, the potentials are respectively 115 volts, 230 volts, 199 volts. Therefore, in cases where the three-phase lighting circuit is taken out of two transformers and it is desired to afford the lighting circuit better protection than is provided for the motor circuit, the ground should be connected at a.

On the motor circuits, the potentials to ground on the 460 volt circuit with the ground connected at b are the same as in Fig. I. The maximum voltage to ground is increased slightly if the ground is connected at a. In general it will be advisable to ground the point a when this connection is used.

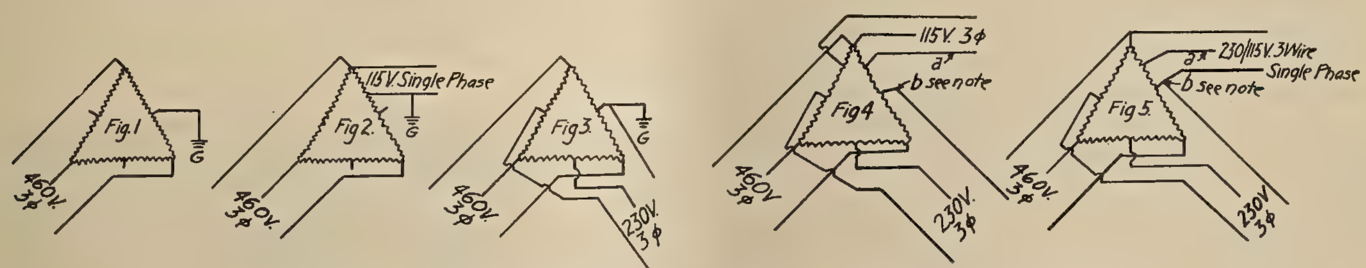
In Fig. V the potentials to ground on the three wire single-phase lighting circuit with a grounded are respectively 115, 0 and 115 volts. With the point b grounded, the potentials become 0, 115 and 230 volts.

With the point b grounded, the potentials on the motor circuits become as in Figs. I and III.

With the point a grounded, the potentials become 345, 115 and 413 on the 460 volt circuit, while on the 230 volt circuit the potentials to ground become 115, 199 and 304 volts.

In case the secondary winding of the transformers is star connected and the voltage of the secondary circuit is less than 500 volts between wires, then the neutral point of the star connection will be grounded.

The circuits may be grounded to the same ground connection that is connected to the transformer cases,



Diagrams of Grounding Connection of Secondary Circuits Less Than 500 Volts.

All transformers connected to distribution circuits of less than 500 volts rating must have their cases thoroughly grounded and the secondary circuits must be grounded with sufficient capacity to blow the primary fuse of the installation. The point of the winding to be grounded is shown by the accompanying drawing for several arrangements of transformers.

Fig. I shows the middle point in one transformer grounded, thus giving a maximum potential to ground of 230 volts from each of two wires and 396 volts for the other wire.

Fig. II, the maximum potential to ground on the lighting circuit is 115 volts. On the three wires of the motor circuit the potentials to ground are respectively 115 volts, 345 volts and 413 volts.

In Fig. III the potentials to ground on the 460 volt three-phase circuit are respectively 230,396 and

but neither connection should have the same ground as the primary arresters. The exception to this is that both systems of ground connection may be made to the same water system, provided the water system is thoroughly grounded between the points of connection for the primary arresters and the secondary circuits.

The secondary ground connections should be made to a thoroughly grounded water pipe system or to a first class ground plate installation, or, if that is not available, three pipes not less than 1 in. diameter may be driven into the ground not closer than 10 ft. together, each pipe not less than 5 ft. long. The ground wire should be connected to each pipe independently.

The ground wire and all its connections at the transformer must be installed to insure its greatest possible safety from mechanical danger.

READINESS TO SERVE METHODS

CITY VS. COUNTRY BUSINESS.

BY R. B. MATEER.

From a central station viewpoint, the superiority of one class of consumers over another, is dependent on the net cash return per dollar of expense occasioned by investment in and maintenance of a distributing system. Therefore, whether it is to be the policy of the utility to extend its overhead system to rural districts for agricultural business or reinforce its present system for additional commercial or residential customers, can only be definitely decided when the applications of current consuming apparatus for the farm are balanced against those practical for the average residence and shop.

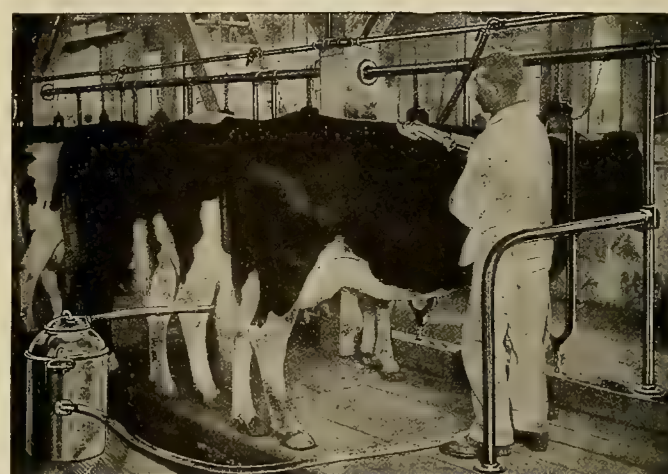
Rural Home, Electrically Equipped.

Consider, if you please, the rural home surrounded with from ten to one hundred acres and the city residence. On either property a comfortable house is erected. The interior wiring is arranged for lighting and power consumption, metered at one point. Ornate electroliers, table and stand lamps, are to be found in the various rooms. Chafing dish, percolator, grill, water heater, range, refrigerator, washing and ironing machines, luminous electric heaters, electric pads, vacuum cleaner, library sets, sealing wax heaters, cigar lighters and pyrographic needles are to be found, instantly available for use and with a total demand at any one period, not in excess of four kilowatts, and an average monthly revenue of $9. It is true that rural business of such a character occasions a greater cost to the lighting company, than the home so equipped in the city, yet it is apparent that only a very small increase, if any, is to be expected in succeeding months statements as rendered to the city resident, while in the country, the field for additional current consuming apparatus is without limit. In the barn, rectifiers are installed for charging the batteries of the runabout, the farm truck, and the ignition battery, used on gasoline propelled lawn-mowers. Motors for operating hay hoists, grain conveyors, feed cutters, wood saws and grinding machinery are placed overhead, yet easily controlled by the auto-starter or knife blade switch. In the dairy are found electrically operated milking machines, separators, churns, fans, refrigerators and water heating apparatus satisfactory, reliable and possessing cleanliness unsurpassed.

In the field is found the pump for irrigation and reclamation purposes and at the house, the motor operated fire pump, both of which insure the estate against loss, the first by drought and the second by fire. And the premium,—only that charge per annum which varies from twelve to sixteen dollars per horsepower maximum demand. Insurance of such a character renders the farmer independent of the elements and places him at a small expense in a position to secure the largest return from his land.

To supply service for the farm including the residence, barn, dairy and pump house transformer capacity of only 20 h.p. is necessary, insuring to the power company, a revenue of $700 per annum or $35 per kw. of transformer capacity. The revenue here noted is that of the first twelve months succeeding the installation and it is reasonable to presume the second year will witness an increase in consumption equal to 60 per cent, with an additional revenue equal to 40 per cent of the first year or approximate a monthly total of $50 per kw. capacity of transformer.

The only reasons for this rapid increase in current for agricultural purposes are the improvement in county roads, the automobile, the extension of telephone, rural delivery and electric service, keeping the farmer in touch with the world's modern progress. With necessities and luxuries at hand, the farmer today is not the isolated individual, but the intelligent business or professional man, the lawyer and the college graduate, who is attracted to the country by its independent, healthy outdoor life, and the financial returns possible by scientific farming. To secure profitable rural business, service extensions should not be retarded by those who have grown up and prospered in a community, yet fail to recognize their obligation to aid in building up enterprises, that will give comfort and happiness to the producing population.



Electrical Milking.

A few of the many points in favor of the sales of current for agricultural purposes, are:

1. Revenue per annum in excess of that of the average city residence.

2. Assurance of an increase in revenue each year as compared with the fluctuation in annual receipts of the urban consumer.

3. Permanency and stability of agricultural business as evident by the few changes in the consumers record at the office.

4. Prompt payment by the farmer of statement rendered.

5. Maximum long hour consumption in summer when the power company can best supply service.

6. Elimination of the bug-bear, the winter peak.

7. The fertile field for the introduction and general use of current consuming apparatus.

8. Minimum of accounting expense by the elimination of charges arising from delinquent accounts, and the absence of numerous shutoff and turn-on items.

9. Few complaints on service.

Analyze your business, not only with reference to the revenue per annum per kilowatt demand, but with relation to the future business assured where service lines are constructed and it will be apparent that agricultural and industrial development present possibilities far in excess of that of a commercial and residential character.

AMERICAN ELECTRICAL SUPPLIES IN JAPAN

[Consul General Thomas Sammons, Yokohama.]

The sale of American electrical machinery and supplies in Japan during 1912 was the largest in the history of this line of business in the Empire. The total sales of electrical supplies for the year aggregated over $5,000,000, the bulk of the imported products coming from America. The importation of all kinds of machinery into Japan increased about $1,500,000 during 1912, the total, in round numbers, being $14,150,000.

There are in Japan several British manufacturers who have a fairly large electrical business, but the Allgemeine Company and the Siemens-Schuckert Company are the two large German competitors of the American manufacturers of heavy electrical machinery and supplies.

The principal business during 1912 consisted of the extension of existing light, power, and railway stations. The Tokyo Municipal Railway, for instance, purchased $300,000 worth of apparatus for transforming high tension current in their various substations throughout the city to the trolley voltage.

Electric Water Power Plants—Osaka a Center for Electrical Business.

The machinery ordered about a year ago at Tokyo for various large water power electric companies has been arriving during the past few months and the plants are being completed.

At Yokohama a 3000 kilowatt steam turbine generator was installed to further increase the capacity of the existing lighting plant.

At Osaka there have been many additions to the existing electric railway plants and some small suburban roads have been put into operation in the last four or five months. Osaka is a very active center for the electrical business in Japan, and many suburban roads have been successfully put into operation there. On account of the large manufacturing interest developed, electric power will be largely used there in the future, and as there is a large water power company, the Ujigawa, which is now nearing completion, and which will bring into Osaka 30,000 to 40,000 kilowatts of current, the prospects are favorable for low cost of light and power in that city in the future.

Other Buyers of Electrical Machinery—Business of General Electric Company.

The Kyushiu Electric Railway added during 1912 a 3000 kilowatt turbo-generator set, and at Nagasaki two 500 kilowatt turbo generator sets were installed as an extension to the existing lighting plant. The coal mines in Kyushiu have also been active in purchasing electrical apparatus.

The major part of the sales reported have been made through the General Electric Company of America. In addition to the extensive business of selling American electrical machinery, the General Electric Company is a leading factor in the electric lamp supply trade in Japan. It has developed a very large lamp manufacturing plant at Tokyo, which now supplies the great bulk of the incandescent lamps used in the empire. This plant is operated through a Japanese company under American control. It is managed entirely by Jananese, however, and the operatives are largely Japanese girls. It has been very successful both financially and in supplying the demands of the country. In fact this is a new industry created in Japan within the last three or four years.

The General Electric Company also owns a considerable interest in the Shibaura Engineering Works at Tokyo, which is controlled by the financially powerful Mitsui Company. The Shibaura works manufacture electrical apparatus up to 2000 kilowatts, and the business for the past six months was so satisfactory that the company has decided to increase its capital from the present $1,000,000 to $2,000,000 to take care of the demands of the market here. There is close cooperation between this company and the parent General Electric Company of Schenectady, N. Y., and there is apparently no reason why this Japanese electrical manufacturing concern should not become very strong and prosperous here. All of its products are manufactured in accordance with American designs of the General Electric Company.

Large quantities of the smaller electrical supplies are imported into Japan, and in this business American manufacturers and importers participate very satisfactorily. It is evident, however, that the Japanese will be able, particularly through foreign associates, to manufacture the greater part of the smaller electrical supplies, including telephones and telephone equipment. The manufacture of this class of small electrical products in Japan is growing steadily and rapidly.

ABSENCE OF ELECTRIC SIGNS IN FRENCH CITIES.

Although electricity is quite cheap here—from 1 to 10 cents per kilowatt hour—and although electric lights and power are quite common, there is not a single electric sign either stationary or "talking" on the shopping streets of Marseille. There ought to be a good trade in these articles.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Power of Salesmanship

Every man at some time in his career is a salesman, whether of such material things as electric irons or of such intangible values as electric service or even his own services. As such, every one can profit much by reading the remarks on salesmanship published elsewhere in these columns. They are "hot off the bat" from one who has proved by practice the truth of what he preaches.

Sales methods are gradually being classified into a science of salesmanship—a science of cause and effect. A sale follows as the effect of certain causes as naturally as does an electric current. Indeed the act of making a sale has many points in common with that of generating electric current.

Dynamic thoughts, impulses to action, can be generated by the power of suggestion and can be transmitted against the buyer's mental resistance so as to do the work of attracting attention, creating confidence, inducing interest and pulling purchasers.

The power of salesmanship is now being applied to increasing the business of central stations. Great results should follow this action, particularly along the excellent lines which have been adopted by the Society of Electrical Development, under the new slogan, "do it electrically."

Fixing the Resale Price

The legality of price fixing is one of the most momentous questions now pending before the courts. The opponents of this practice claim that it is conspiracy in restraint of trade and adds to the increasingly high cost of living. Its advocates stand on the ground that the maker has the right to name the price at which his product shall be sold.

Like many another good thing in life, the evil in this custom resides not in its use, but in its abuse. When a retail price is ostensibly and ostentatiously fixed at an exorbitant figure so as to allow an opportunity for dickering, the business is more crooked than the proverbial ram's horn; its very deviousness deceives the unskilled buyer. But when the retail price is scrupulously maintained as established and published, all consumers are equally protected.

The important point is that the prices be published, so that goods can be sold on the basis of merit as compared to price. Truthful publicity is the keynote of the new competition, based upon excellence, justice, fair dealing and the approval of a discriminating public. Price-fixing by the manufacturer who advertises builds the finest and the fairest competition the world has ever known. Like the quality of mercy, it is not strained; it helps him who makes and him who buys. It insures a fair profit to the manufacturer and the retailer, a living wage to the workman and equal treatment to all consumers.

Then, again, there is the moral effect of stifling individual effort and initiative. If price-fixing is to

be made a crime, punishable by fine and imprisonment, whereas price-cutting has long been penalized by business suicide, why be a manufacturer, why make things that make for progress, why provide work for the world's workers? Freak law-tinkerers and inconsistent courts may temporarily obscure the issue by reversing the current through the intensified arc of truth, but an awakened people will then the more easily discover and right the error.

Nature's Lesson to the Engineer

The modern engineer has been so busily engaged in studying "the sermons in stones," in developing the latent powers of inanimate nature, that he has sadly neglected the biblical admonition "to consider the ant." Insect life has found better solutions for many a problem than has all the much boasted skill of the engineer. The ant, in addition to being a most advanced exponent of sociological reform, is a tunnel engineer of no mean attainments. On the basis of size comparison, ant structures, both above and below ground, rival any that the structural engineer has yet designed.

Consider also the spider, one of the most repulsive of insects, the comparative span of whose web transcends that of the greatest of man-built suspension bridges. Surveying and astronomy owe a deep debt to this humble hermit, for after many years of experience the astronomer has found the spider-line to be the only cross-hair which combines the necessary fineness with the requisite strength, elasticity and ability to withstand variations in temperature. The spider line is the original "squirted filament" consisting of thousands of microscopic streams of fluid uniting to form a single thread. It is for this reason that it remains true and round under the highest magnifying power.

The hexagonal cell of the honey-comb of the bee is the model for one of the strongest structures known to the engineer. The stream lines in the bodily form of a fish or bird have furnished the naval architect and the aviator with many an idea embodied in aerial or water craft.

Engineers, however, by their continual struggle against the forces of nature have avoided one failing of which the bird has been accused. The locomotive superiority over the ordinary terrestial creature imparted by the power of flight, although a source of great happiness to birds, has lightened their burden of life and perhaps has dulled their wits. Instead of developing a large brain, they have dissipated their energy in flight, song and gorgeous plumage. In this respect, then, birds may be said to form a back-water in the stream of evolution, whereas the engineer is in the forefront of the flood.

It is to the competition of the fire-fly and glow-worm, though, that the engineer must surrender all laurels. Light, without sensible heat, and an efficiency of nearly one hundred per cent, completely eclipses the most brilliant effort of the illuminating engineer in liberating the pent energies of the sun, of which the light of the glow-worm hidden in the grass the gleam of the Noctiluca, disturbed by the ship's keel, or the sudden luminous expulsion of the deep-sea crab are but manifestations.

From a material point of view, modern life owes much to a study of such apparently trivial subjects as these. Witness the marvelous results which have followed Galvani's experiments with the legs of a frog or the evolution of a toy magnet into a turbo-generator. The immediate demands for some practical application of his knowledge has often prevented the engineer from carrying his studies to their logical conclusions and enriching the world with the fruits of his investigations.

The California Blue Sky Law

Irrespective of individual opinion as to the merits and demerits of the laws which have been enacted by the California legislature during the session just closed, no one will controvert the statement that as a whole they are the most radical ever passed by any state legislature. Through the strange irony of fate many of them are likely to be repealed by the people through the medium of the initiative which was established in this state by the political party which apparently recks so little of the wrecks it may cause in statesmanship or finance. One law, however, is likely to stand as a monumental light house to safeguard the interests of the investor. Following the lead of other progressive states, an adequate "blue sky law" now is ready for enforcement.

By a "blue sky law" no reference is intended to the campaign for industrial smoke prevention concerning which this term is frequently employed. Blue sky is a figurative expression for publicity, freedom from haziness, and refers to those financial transactions which might be characterized as shady.

The provisions of the bill are directed primarily against the unscrupulous get-rich-quick promoters of mining and oil stocks, a nefarious class which heretofore could be reached only indirectly through federal means. It is in no way concerned with the public service corporations, which are already under the control of other adequate commissions, state or federal. Its control over all other investment companies is most drastic, the intention being to eliminate all forms of wild-cat speculators in the state.

No securities can be issued by any corporation coming under the provisions of this act until a permissive certificate shall have been granted by the "commisioner of corporations" after he has made due examination as to the financial condition and purposes of the company. Semi-annual reports must be filed, subject to public inspection, though the commissioner is given discretion to withhold any information if he deems it to the best interest of the public or the corporation. Deceptive statements in advertisements or elsewhere are made unlawful and subject to severe penalties, as are all other violations of the act. The certificate is revocable should the commission find at any time that the "proposed plan of business is unfair, unjust or inequitable."

Great power is thus seen to reside in the discretion of the commissioner and the effectiveness of the law is in a large measure dependent upon his integrity.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Paul Shoup, president of the Pacific Electric Railway Company, is at San Francisco from Los Angeles.

Elmer Dover, head of the Western States Gas & Electric Company at Tacoma, Wash., is at San Francisco.

S. J. Keese, manager of the Westinghouse Company, Los Angeles, has been spending a few days in San Francisco.

A. G. Wishon, general manager of the San Joaquin Light and Power Company, was at San Francisco during the past week.

S. B. Gregory, Pacific Coast manager for the Arrow Electric Company, has returned to his San Francisco offices from Los Angeles.

H. E. Grant, sales engineer with the Holophane Works of the General Electric Company, has returned to San Francisco from Vancouver, B. C.

J. O. Presbrey, general representative of the Holophane Works, and **H. N. Lauritzen**, Pacific Coast manager for the company, are at Los Angeles.

Carl Heise, manager of Westinghouse Electric & Manufacturing Company, San Francisco, is on the road to recovery from a very painful accident.

W. H. Banes, formerly with J. C. English & Company of Portland, is now superintendent for Cope & Sons, electrical manufacturers at Vancouver, B. C.

J. G. Behneman, dealer in electrical supplies, Seattle, has added **W. H. Morrow**, formerly with the Pacific Telephone & Telegraph Company to his sales force.

F. W. Wilson, formerly associated with the Asbestos Manufacturing and Supply Company, has become identified with the Standard Underground Cable Company at their San Francisco office.

George Locke, formerly with the Denver Gas & Electric Company, has been made commercial manager of the Honolulu Gas & Electric Company at Honolulu, Hawaii.

Fred Skeel, Western manager of Crouse-Hinds Company, Syracuse, is in California, and is due to arrive in San Francisco from the southern part of the State the first part of the week.

Geo. Boring, sales manager at Portland, **F. J. Airey** of Los Angeles, and **E. A. Norton**, Seattle, are attending a sales managers' meeting of the Pacific States Electric Company in San Francisco.

O. H. Ensign, chief electrical engineer, United States Reclamation Service, Los Angeles, Cal., has been transferred to the grade of Fellow of the American Institute of Electrical Engineers.

J. G. Deremer, chief engineer with the United Light & Power Company, has just returned to San Francisco from a few weeks' stay in Southern California, during which time he visited the aqueduct project.

Jesse S. Jones of Tacoma, member of the Washington public service commission for the past six years, has severed his connection with that department and has been succeeded by **Arthur A. Lewis** of Spokane.

O. W. Petersen has been appointed assistant superintendent at the Lake Spaulding development of the Pacific Gas & Electric Company, and **M. H. Richards**, assistant superintendent of developments Nos. 4 and 5.

W. B. Mel, formerly superintendent of light and power at the plant of the University of California, has joined the electrical engineering staff of the Pacific Gas & Electric Company, under the direction of Frank Varney.

R. F. Behan, assistant to manager of Westinghouse Electric & Manufacturing Company, and **R. A. Balzari** were lecturers before the the Pacific Gas and Electric Company recently, the subject of the talk being on "Small Motor Applications."

E. B. Bumstead, vice-president of the Oro Electric Corporation, left San Francisco for the East this week. All new construction has been discontinued by the company and 600 or more employees have been let out. Lack of funds is stated to be the cause.

A. L. Humphreys of Pittsburgh, Pa., vice-president and general manager, and **C. J. Olmstead** of Chicago, general Western manager of the Westinghouse Electric and Manufacturing Company, are at San Francisco on an inspection tour of the company's business on the Pacific Coast. They will spend several days here going over the affairs of the branch plant established at Emeryville a year ago.

W. J. Grambs, superintendent of light and power and **G. E. Quinan**, operating superintendent of the Puget Sound Traction, Light & Power Company, Seattle, left May 17th to attend the National District Heat Association, to be held at Indianapolis, May 27th to 29th, and the 36th annual convention of the National Electric Light Association to be held in Chicago June 2d to 6th. After the latter convention Mr. Quinan will return to Seattle while Mr. Grambs will visit cities on the Atlantic Coast.

James E. Barker, engineer on the Board of Public Utilities, Los Angeles, **V. Y. Davoud**, electrical and mechanical engineer with the Utah Power & Light Company at Salt Lake City, **Thomas Foulkes**, Commissioner on the Board of Public Utilities, Los Angeles, **S. R. Inch**, general superintendent Utah Power & Light Company, Salt Lake City, **A. S. Kalenborn**, engineer of distribution for the Oro Electric Corporation, San Francisco, **E. R. Northmore**, superintendent of electrical distribution for Los Angeles Gas & Electric Corporation, Los Angeles, and **E. Woodbury**, engineer of electrical construction with the Pacific Light & Power Corporation, Los Angeles, have been transferred to the grade of Member of the American Institute of Electrical Engineers.

B. S. Josselyn, president of the Portland Railway, Light & Power Company, was the guest at a banquet tendered to him by the Portland Electric Council of the Royal Arcanum, on May 16. **W. T. Buchanan** acted as toastmaster and the first speaker was **Franklin T. Griffith**, who on July 1, will succeed Mr. Josselyn as president of the Portland Railway, Light & Power Company. He was followed by **George W. Hazen**, past regent of Multnomah Council; **C. J. Franklin**, past regent of Portland Electric Council; **H. C. Webber**, past regent of Multnomah; **J. F. McKinney** of Portland Electric Council; **J. E. Wellein**, deputy representative of the grand lodge of the Royal Arcanum.

NEWS OF GOLDEN POPPY SPECIAL NO. 2.

The energetic work of the past few weeks has materialized in a large list of reservations for the Golden Poppy Special No. 2, which will leave San Francisco on May 29th for the Chicago convention of the National Electric Light Association. The local entertainment committee has prepared a most attractive program enroute.

Mr. E. B. Strong, chairman of the Western Transportation Committee announces that on and after Monday, May 26th, headquarters will be established in the Southern Pacific ticket offices in the Palace Hotel at New Montgomery and Market streets.

The following cordial invitation has been received from the Utah Electric Club:

The Utah Electric Club and local members of the N. E. L. A. take this opportunity to invite the delegates enroute to the N. E. L. A. Convention at Chicago, to stop off at Salt Lake City for the few hours you may be in our city.

A committee has been appointed to take charge of this

entertainment, and we shall expect you to arrive in Salt Lake City on May 30th, at 10:30 a. m., and will provide entertainment until 3:00 p. m. A part of this committee will meet you in Ogden and hand you at this point a program explaining the entertainment for the day.

Hoping to have the pleasure of receiving a favorable reply to this invitation, we wish to remain.

Very truly yours,
THE UTAH ELECTRIC CLUB,
(Signed) C. B. Hawley, President.

MEETING NOTICES.

Electrical League of Southern California.

Tuesday, May 13th, was Ladies' Day with the Electrical League of Southern California, nearly ninety members and fair guests being present. An excellent address was given on the public school system. On April 20th T. P. Lukens, ex-forest supervisor, spoke on the Forest Service.

Oregon Technical Club.

Dr. Calvin G. White, president of the State Board o. Health, addressed the members of the Oregon Technical Club at their regular luncheon at the Commercial Club on Monday May 12th. Dr. White spoke on "Water Supply for Cities and Towns of Oregon." Mr. R. G. Dieck, consulting civil engineer, was chairman of the day.

Electrical Development and Jovian League.

Last Tuesday was Jovian Day with the League, the Jovians under the direction of Statesman Halloran having charge of the meeting. Practical demonstration of the pulmoter was the feature of the meeting and proved to be a subject of utmost interest. The jobbers are to take charge of next week's meeting.

Pacific Claim Agents' Association.

The Pacific Claim Agents' Association will hold its fifth annual convention at Vancouver, B. C., July 10, 11, 12. George Carson, claim agent of the Puget Sound Traction, Light & Power Company, Seattle, is president of the association and Ida P. Newel of the Portland Railway, Light & Power Company, is secretary-treasurer.

Seattle Section, A. I. E. E.

The May meeting of the Seattle Section of the American Institute of Electrical Engineers was held Tuesday evening, May 20th, in the assembly hall of the Chamber of Commerce, under the auspices of the Committee on Transmission, Substations and Distribution. Four ten-minute papers were presented as follows: "High Tension Transmission," by M. T. Crawford; "Substation Construction," by C. F. Terrell; "Alternating Current Distribution Systems," by N. C. Nelson; "Direct Current Distribution Systems," by C. R. Collins. Prepared discussion was also contributed by several other local engineers engaged in work along these lines.

Puget Sound Traction, Light & Power Company.

A meeting of the Central and Division Safety Committees of the Puget Sound Traction, Light & Power Company was held in the assembly room of the company's building on May 8th at which 65 members were in attendance. George Carson, claim agent of the company and chairman of the Central Safety Company, presided. The meeting had for its object a discussion of the accident situation. The chairman called attention to the fact that the organization of the safety committees had proved more successful by far than had been anticipated; that general operation had much improved and gave every promise of continuing to improve. The relations between the officials of the company and the men in the ranks had become closer and more satisfactory since the organization. Much statistical information was submitted by the chair together with pertinent comment and suggestions in relation to the various classes of accidents. He also reviewed the reports made by the various members of the Division Safety Committees as well as the action taken on same.

A. L. Kempster, general superintendent of the company; D. W. Henderson, superintendent of transportation; G. P. James, chief engineer; C. B. Harrington, assistant general superintendent; J. D. Nice and W. A. Burrell, division superintendents, took part in the discussion, after which the meeting was thrown open to all members desiring to speak on matters of interest to operation, resulting in many valuable suggestions being offered.

The chairman closed the meeting by making a plea for the new men entering the service, urging that they be assisted as much as possible with their work by the various members of the committees. He also urged that members continue to send in reports even though their terms of appointment on the safety committees might have expired. The session, lasting two hours, proved very interesting.

SOCIETY FOF ELECTRICAL DEVELOPMENT.

The annual meeting of the Society for Electrical Development was called in accordance with the by-laws at 11:30 a. m., May 13th, and adjourned to convene in Chicago, June 2d, at the Hotel Sherman at 11 a. m., for the greater convenience of the members of the Society who would attend the annual convention of the National Electric Light Association and for the convenience of those members of the National Electric Light Association from the West who would have found it difficult otherwise to come east on two different occasions.

The regular annual meeting of the Board of Directors was held and an enormous amount of preparatory work done to put everything in readiness for the meeting of the 31st.

The financial statement of the Society showed an amount considerably in excess of $100,000 has already been pledged to assist in carrying out the work of the society when the active work will be started, which will be when minimum subscriptions have been made to the amount of $200,000. Also the financial statement showed that there was still on hand in cash from the advance subscriptions made by the board of directors of the society, a sufficient amount to carry out the further necessary organization work, and obtaining of members up to the desired amount, and the committee approved of an additional expenditure to publish a booklet covering the history of the society, together with the complete plans of the contemplated work, by-laws, etc.

Also the committee approved the engaging of an editorial or publicity man who could begin a certain amount of collection of material, and in the meantime be of assistance to the present staff of the society in developing the membership and other work. Mr. Stephen L. Coles well known throughout the electrical industry as a former managing editor of the Electrical Review, will be affiliated with the society in this position.

Appointment was made of a nominating committee who will make their report for nomination for officers and directors before the full membership at the annual meeting in Chicago.

Further the committee approved the report of the committee on plans, which committee met May 6th and laid out from the great mass of ideas and suggestions made a definite concrete plan for the active work of the society. The general aims of the society already have the approval of the public policy committee and executive committee of the National Electric Light Association, and also the approval of the National Electrical Supply Jobbers' Association, the National Electrical Contractors' Association and a number of the representative electrical manufacturers and the detail plans as approved by the plans committee and board of directors are as follows:

Advertising.

A national advertising campaign in general magazines, trade and class papers, etc., this campaign to be of a broad

educational nature designed to educate the consuming and non-consuming public to the many advantages of electricity for light, heat, power and other useful purposes, including special arguments for adequate wiring circuits, outlets, etc.

A comprehensive follow-up system in connection with the above, so that each individual member will receive a copy or notification of every inquiry coming from his locality, and the manufacturing members will receive direct copy or notification of every inquiry made relating to the apparatus which they manufacture.

Stimulating and assisting in the publication of educational literature of various kinds to architects, builders, other trades and the public, including publications of a similar character to those now being issued by the commercial section of the National Electric Light Association, Illuminating Engineering Society and by other outside agencies, and where it is not possible to stimulate the publication of booklets of this character, organization of this department to prepare those which seem necessary or advisable.

Booklets of an educational nature to be used as far as possible in answering direct inquiries coming from national advertising and other sources and also to be supplied in quantities at a minimum cost to members of local distribution through co-operation with above agencies.

Collecting of material from central stations, manufacturers, advertising agencies, etc., and preparation of additional material if advisable, so that specific information can be furnished relative to advertising copy and cuts for newspaper advertising, booklets, folders, envelope stuffers, circular letters, etc., to assist members in planning and carrying out advertising campaigns. This can be accomplished at low cost by close co-oporation with members, advertising agencies, etc.

Advising and arranging for and furnishing material for national publicity and advertising weeks (or months) on certain phases of electricity.

Accumulating and furnishing to members data regarding development and sales campaigns to increase the use of electric signs, improve and develop street lighting, power, heating, etc.

Maintaining of information bureau for statistics and data of various kinds relating to commercial subjects—merchandising, selling campaigns, advertising, etc.

Publicity.

The accumulating and disseminating of data, photographs, etc., for use in newspapers, general magazines, trade and class papers, as well as to free lance writers, furnishing data, articles and stories of all character to all class of publications, including architectural, building, farm publications, women's magazines, etc., etc.

Furnishing articles and information to the trade press as well as the bulletins of the National Electric Light Association, the Jovian Order, National Electrical Contractor, Illuminating Engineering Society, Efficiency Society, etc., etc.

Furnishing of news material to co-operative newspaper pages where requested.

Furnishing of a news service to members to be used locally in newspapers.

Arranging with newspapers through the country and with magazines, newspaper syndicates, trade press, special writers, etc., for stories, articles and information.

Preparing and disseminating of articles and information which will assist in the unification of water power laws, electrical ordinances, sign and wiring regulations and the like.

Preventing as far as possible the publication of untrue articles or stories tending to injure the business or mislead the public and to correct any misinformation published.

Field and General Effort.

Co-operation with Jovians and other electrical societies and organizations as a national proposition and locally among the various branches and local leagues to obtain co-operation in the industry and in the carrying out of the society's work.

Suggesting various ways and means for co-operation among the different electrical interests in the electrical and allied industries and stimulating as far as possible more harmonious relations and wider co-operation among the various interests engaged and either by stimulating local endeavor or by carrying out work direct, assist in various lines of local development, etc., etc.

Suggesting ways and means of co-operation locally in the various cities with the chambers of commerce, boards of trade, etc., for the development of the electrical business and the development of cities.

Addresses by trained men before various electrical societies and before architectural, building trades and various other industries to increase co-operation and acquaint them with the greater value of electricity for light, heat, power and all other useful purposes.

Working nationally and locally for better co-operation with underwriters' laboratories throughout the electrical business, to improve conditions generally, a special committee to be appointed for this purpose.

Stimulating and assisting in organization of co-operative community advertising.

Arranging locally for equipping of various industrial plants for electricity to the fullest point of saturation.

Exchanging information regarding plants so equipped and arranging for publicity throughout the industry and to the public regarding such plants.

Assisting in plans for bureau for lectures and demonstrations in various cities.

Assisting general co-operative plans for moving picture exhibitions, exchanging of films, etc., perhaps in connection with traveling electrical show.

Assisting by suggestion in ways and means for developing day load, electricity on the farm, household appliances, power, etc.

The committee reported that after due consideration of such advertising agencies who had communicated with the society relative to handling of the society's account and of such other agencies as the committee has knowledge of, that Frank Presbrey Company of New York be engaged.

The committee further recommended that Mr. C. W. Lee and Mr. Frank B. Rae Jr. be engaged on some basis to assist in carrying out special advertising plans of the society.

Also the board of directors approved the awards as given in the report of the committee on design and slogan contest, which report follows:

"Meeting held May 5, 1913, in the offices of the society.

"The committee reports after careful consideration of the 2675 designs and slogans submitted by the various contestants, that the prize of $100 for the most suitable design was awarded to the design submitted by Philip S. Dodd.

"The prize for the slogan was awarded to five contestants who have submitted the same slogan. The five contestants being:

"J. A. Burk, United Electric Light & Power Company.

"E. B. Featherstone, Pacific Gas & Electric Company, San Jose, Cal.

"Max Loewenthal, New York.

"C. B. Briggers, League of Jovian Interests, St. Louis, Mo.

"K. Tornberg, 91 Hanover street, Lynn, Mass.

"Mr. Dodd being an officer of the society, has added the amount of the design prize, viz: $100, to the $100 offered for the most suitable slogan and the total, viz. $200, will be divided among the five contestants who have submitted the winning slogan."

It was decided that the great mass of material correlated in the various papers and discussions at the conference held March 4th and 5th would be bound together in an inexpensive volume and distributed on request.

A special committee was appointed to prepare sugges-

tions for an amendment to the constitution covering the classification of members. It appears that there has been some objection on the part of some of the electrical interests to subscribing on the basis of their gross annual sales through the belief that it would be necessary to divulge what their annual sales would be and for this reason while the suggestion was that the proportions would remain the same, that some method be worked out whereby it would not be necessary to state so absolutely just what the volume was in each case.

SERVICE
ECONOMY THE SOCIETY FOR ELECTRICAL DEVELOPMENT ·INC NEW YORK EFFICIENCY
SAFETY

"DO IT ELECTRICALLY."

Mr. Charles E. Brown of the Central Electrical Company, Chicago, was elected as a director of the society to take the place of R. V. Scudder, deceased, and Mr. John R. Galloway of Washington, D. C., was elected as a director to take the place of P. N. Thorpe, resigned.

The board of directors of the society recommend strongly to the members of the society that the design and slogan selected for the society be used on the stationery and in all trade paper, magazine and newspaper advertising, also on all house organs issued by the members and in every other way possible.

PICNIC OF GENERAL ELECTRIC AND PACIFIC STATES ELECTRIC COMPANIES.

On May 17th the General Electric Company and the Pacific States Electric Company held a council and resolved "when business interferes with pleasure, give up business"; they put the resolution into execution, screwed down the business lid tighter than a sheriff attachment, and office boys and bosses, sweethearts, wives and babies betook themselves to Idylwood Park, a beautiful spot in Niles Canyon on the Western Pacific road.

Arriving at the grounds, the first serious business was the baseball game between the Pacific States and the General Electric, the former being given the decision.

The gate prize was then decided in a way to make all hopeful and nervous for a while. The numbers of all the railroad tickets were put in ten hats. Two numbers were then drawn from each hat by dainty little Miss Stotler. Then these twenty numbers were drawn from another hat, the last two being the winners. Miss Olga Zachau won the prize and took the grip. But she will not call in a doctor.

The tug of war was won by the Pacific States team that averaged 198 to the man as against 210 for the G. E. team.

The racing was relayed off to a crowd of interested rooters. C. H. Tallant of the G. E. won the Paul Carroll hat for the 100 yard, but had to clean out twenty others by the elimination process to get it.

The ladies' 50 yard dash was won by Miss Marion Ross in dashing style.

The pie eating contest was a scream for everybody but the eaters, they were too busy. Their hands are tied and the only tools allowed in the game are the respective faces. They gouge, they bite, they scoop, they lick, they burrow from throat to forehead, from ear to ear, from Siskiyou to San Diego is huckleberry. Moseley inflicted the most punishment to the pies. Fagan succeeded in assimilating the most on the outside of his face but Pacific States Marra got the most inside of his and won the prize.

The other prizes awarded were: Bean bag throwing, under seven years, Ellen Bwelly won a game; under twelve, roller skates, won by George Curtis, sack race, scarf pin, won by Ray Kahn; hop, skip and jump, an umbrella, won by Mr. Coombs; baseball throwing for ladies, a cut glass fruit bowl, won by Miss Pierce.

Rain began to fall about four o'clock after the games were well over, which drove the crowd to cover in the dance pavilion. Dancing was continued until six o'clock, the time set for leaving. The day, while overcast, was propitious for the scheduled sport and the rain was merely an incident that detracted from no one's pleasure.

NEWS OF ELECTRICAL CONTRACTORS.

The Electrical Engineering Company, 112 Marion street, Seattle, will soon start on the job of wiring the new Sun building now under construction on Fifth avenue, between Pike and Union streets.

Davis & Hall, electrical contractors and engineers, Tacoma, have practically finished the electrical work on the lift bridge across the Puyallup River in the tide flat section. The equipment is similar to that used in the Eleventh street bridge, installed by this firm some time ago.

Wm. A. Mullins Electric Company, Tacoma, has the contract for wiring the new hollow tile residence of John Chalmers. There will be about 40 outlets, together with switches, underground service and conduit. The company has just completed wiring the residence of J. R. Thompson at Lake Steilacoom.

The contract for equipping the new Central school at Tacoma with electrical elevators was let to the Washington Machinery & Elevator Company, a local concern, at $2800.

The A. G. Electrical & Manufacturing Company, Seattle, recently furnished for the new Empress theater at Portland a special type of rotary alphabetical announcing board. A telegraphic order has also been received for a complete equipment of this kind for Pantages theater at Edmonton, Alberta.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The railroad commission rendered a decision granting a certificate of public convenience and necessity to the Los Angeles Gas & Electric Corporation to exercise rights and privileges granted by the city of Eagle Rock and by the city of Watts.

A decision was rendered granting the application of Southern Sierras Power Company for a certificate of public convenience and necessity to operate under franchise in Kern county.

A decision was rendered fixing the gas rate for the Southern Counties Gas Company, in the city of Orange, at $1.22 per thousand cubic feet. The former rate of $1.15 was found to be unreasonably low, in view of the circumstances involved.

The Southern California Edison Company has applied for a certificate of public convenience and necessity for the construction of an electric distribution system in Beaumont.

A supplemental decision was rendered providing that the Northern California Power Company should make returns to its patrons of all moneys previously collected in excess of the established rates.

The Great Western Power Company has applied for an order preliminary to the issuance of a certificate of public convenience and necessity to exercise franchise rights in Contra Costa county.

NEWS NOTES

INCORPORATIONS.

SALEM, ORE.—The Santiam Water Company has been organized with a capital stock of $300,000 to supply Salem and neighboring towns with water from the north fork of the Santiam River. The incorporators are W. E. Pierce of Boise. Chas. Theis of Spokane, John D. Turner of Salem. The offices will be at Salem. The company will lay a line from the Little North Fork to Salem and the state institutions.

ILLUMINATION.

FLAGSTAFF, ARIZ.—A franchise has been granted to the Flagstaff Electric Light Company, for electric light plant, upon which work will begin at once.

UNION, ORE.—The council has rejected the bid of Green Bros, of Spokane for the installation of a municipal electric lighting plant.

OLYMPIA, WASH.—The city of Olympia has granted an electric power franchise and a steam heating franchise to the Lemon-Foshay syndicate of that city.

BAKER, ORE.—The council has authorized the mayor to employ the services of a competent engineer to estimate the cost of construction of a lighting system.

GREAT FALLS, MONT.—The Libby Water, Electric Light & Power Company, owning the Libby water and light systems, will expend about $7000 during the summer on improvements.

OAKLAND, CAL.—An ordinance was passed by the council granting to the Great Western Power Company, permission to erect, construct and maintain poles, towers and piers for transmitting electricity in the county of Alameda for a period of 35 years.

EDMONTON, ALTA.—Rate payers will be asked to decide at a special election the question of the city supplying natural gas from municipal well or buying gas at the city limits and selling from the municipal distributing plant. Estimated cost of distributing plant, $2,500,000.

NEZ PERCE, IDAHO.—The Lewis Electric Company, with all its light and water plants in Lewis and Clearwater counties, becomes the property of and part of the Grangeville Electric Light & Power Company. E. T. Scholer of Lind will superintend the operations of the newly acquired property.

TRANSMISSION.

ASTORIA, ORE.—Wm. H. Galvani, engineer in charge, has been here perfecting plans for the extension of the power and light lines of the Pacific Power & Light Company to Warrenton, Hammond, Fort Stevens and Clatsop Plains to Gearhart Park.

CULBERTSON, MONT.—The Montana Power Company has come into possession of the entire capital stock of the Thompson Falls Power Company, the Great Falls Water Power & Townsite Company and all rights, title and interest in the Missoula River Power Company sites.

FRESNO, CAL.—The San Joaquin Light & Power Company is getting ready to install a 10,000 volt distributing line to supply the Barstow Colony with electric power for pumping and domestic purposes. The line will be about 10 miles long and will be built from a point near Rolinda to the San Joaquin River. Laterals will be built to the individual consumers along the line.

FRESNO, CAL.—The survey for the transmission line of the San Joaquin Light & Power Company between Porterville and Formosa has been completed and the company will start work on the line immediately. This 60,000-volt transmission line, when completed, will form a complete circuit of high power lines about Fresno connecting Merced, Coalinga Taft, Bakersfield and Porterville with the power plant in Crane Valley. The new substation at Formosa has just been completed. This station will supply the McFarland and Wasco territories.

SAN FRANCISCO, CAL.—F. G. Baum, chief engineer of the hydroelectric department of the Pacific Gas & Electric Company, has returned from a tour of inspection of the new construction under way in the vicinity of Lake Spaulding. He reports that the big dam is now 43 ft. above the river bottom, and that all that remains to be done on the mile-long tunnel is a little trimming. The canal from Bear Valley is more than half completed. At Christian Valley and Auburn two dams are completed, and two more are being begun. The canal between Clipper Gap and Auburn should be finished by August 1. The Christian Valley dams will furnish 10,000 h.p. of electric energy, and the works at Auburn 17,000 h.p. Indications point to the completion of the Lake Spaulding dam this year. Its total height will be 305 ft. and the work is progressing at the rate of 1000 cu. yds. of concrete a day.

LOYALTON, CAL.—The Mountain Devolpment Company will begin construction by June 15th of its reservoir and power plant near Sattley. The plans for the project, which will cost $180,000, call for the diversion of Berry Creek and a main reservoir in Wild Bill Canyon. The principal dam will be 50 ft. high, 230 ft. long at the top and 60 ft. long at the bottom. It will be 35 ft. thick at the bottom and 7 ft. at the top. The reservoir capacity will be 150 acre feet. The company plans an additional small dam across a slight depression at one side of the valley sufficiently to restrain an additional 35 acre feet, making the total capacity of the reservoir 185 acre feet. Two smaller auxiliary reservoirs will be built farther up the same canyon. There is a fall of 1385 ft. from the reservoir to the site of the power plant in the valley below, and approximately 3500 h.p. will be developed.

SEATTLE, WASH.—City Engineer A. H. Dimock of Seattle has recommended that the city acquire the Lake Cushman power project which has been offered at $640,000. The cost of developing the project is estimated at $5,063,000. The purchase of the property was authorized by the voters in March, 1911. This vote was held to be advisory and not mandatory. The report of the city engineer outlines the plan of development to be the construction of a dam three miles below Lake Cushman across the Skokomish River, 240 ft. high and 300 ft. long. This would form a lake eight miles long, including Lake Cushman, the waters of which would be raised 150 ft., making a water area of 5½ square miles. A power house on Hood canal would form a part of the development. By constructing the dam below Lake Cushman Mr. Dimock estimates that the storage area would be equal to 217,000 acre feet capable of developing for 12 hours a day, 70,000 h.p. The plan outlined anticipates the transmission of current over high tension lines. The report was referred to the city utilities and finance committees.

TRANSPORTATION.

TACOMA, WASH.—Tacoma voters have defeated a proposal to issue bonds for the construction and operation of a municipal street car line connecting the city with the manufacturing district on the tide flats.

VANCOUVER, B. C.—A contract has been let by the British Columbia Electric Railway Company for a $40,000 club house to Geo. Snider & Brethour. The contract for heating has been let to Kydd Bros.; plumbing fixtures to Musgrove & Blake.

GLENDALE, CAL.—Sealed bids will be received up to June 9th for a franchise granting the right to construct and maintain for a peirod of 50 years, single or double track electric railroad upon and along certain public highways in this city.

SANTA BARBARA, CAL.—Sealed bids will be received up to June 12th, for the purchase of a franchise, granting the right to construct and maintain for a period of years ending in 1957, single or double track railway (street) along certain streets in Santa Barbara.

SAN BERNARDINO, CAL.—Work on a new trunk line of the Pacific Electric Company between Upland and San Bernardino will begin at Fontana, just west of Rialto, on June 7th. There is a 22 mile gap to be built, and work will be completed within six months.

KLAMATH FALLS, ORE.—Geo. Clark of this valley has been informed by Chicago capitalists that they will build an electric line from Klamath Falls to Bonanza, thence to Dairy, on condition that the Klamath people furnish the necessary rights of way without cost to the builders. Surveys have been made over the proposed route and a right of way has been secured as far as the Horton ranch.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has begun work on the extension of the Hawthorne avenue car line. One mile of new track will be laid through the South Mount Tabor district. It starts at East Sixtieth and will be laid on East Division to East Sixty-first, then south to Twenty-ninth avenue and then eastward to East Seventy-fourth street.

MEDFORD, ORE.—The interurban franchise originally secured by the Minney Company of Oakland in January transferred to Colonel F. B. Waite of Roseburg, in March transferred by the Medford City Council was for the third time transferred to S. S. Bullis & Sons of New York, who declare they will begin construction of the electric line within ten days.

SAN FRANCISCO, CAL.—The Board of Works has been directed by the supervisors to file plans and estimates of the cost of a system of municipal street railways from the Embarcadero to terminals at the exposition grounds and the Presidio; also from various points on Market street through Stockton street to the same terminals, and from Market street to the Potrero district; on Van Ness avenue and along connecting streets to Church street, and along California street from Thirty-third avenue to First avenue, and over connecting streets to Geary street. The bill, which carried unanimously on final passage, provides also for the purchase of land and equipment and such extensions and additions to the system as may be deemed necessary.

TELEPHONE AND TELEGRAPH.

LEWISTON, IDAHO.—The Lewiston Orchards Rural Telephone Company will construct a line to serve Lewiston Orchards, under the direction of W. H. Bankson, president of the company.

SALEM, ORE.—The railroad commission has granted petitions of the Pacific Telephone & Telegraph Company to discontinue telephone offices in 67 towns. The reasons assigned by the company were that competent agents could not be obtained and receipts were small. All the towns have other telephone service and may be connected with the long-distance lines of the Pacific Telephon & Telegraph Company.

SAN FRANCISCO, CAL.—A more perfect telephone system has never been devised than the one that is to be installed in the Liberal Arts Building of the Panama-Pacific International Exposition. A huge switchboard will be erected in the center of the building by the Pacific Telephone & Telegraph Company and with thirty operators at work, that switchboard will connect with all departments of the exposition all concessions, rendezvous, clubs and exhibit sections and will be in direct line for long distance calls, local and exposition connections. The exposition will be equipped with two thousand telephone stations and innumerable public booths which will be scattered all over the grounds at convenient points for public usage. An interesting feature of the installation will be that the giant switchboard will be enclosed in a tremendous case of glass, surrounded by a brass rail. Visitors to the exposition will be able to watch a call put in to the main station and then see how it is connected with the party called.

WATERWORKS.

VALE, ORE.—The contract for the construction of the diversion dam and canal, Malheur Irrigation Project, has been awarded to Wells Bros., Portland.

COLTON, CAL.—The Empire Water Company has made application for permission to sell $200,000 worth of bonds for a hydroelectric plant in Coyote creek, San Diego county.

SALEM, ORE.—The state desert land board has instructed Engineer O. Laurgaard to start work at once on the Columbia Southern project in Crook county, for which the legislature appropriated $450,000. The name has been changed to Tumalo project.

LAWNDALE, CAL.—The state railroad commission has granted authority to the Lawndale Land & Water Company to purchase the system of the Lawndale Water Company, to issue $75,000 of stock and $25,000 of bonds; and to change from a flat rate basis to a meter basis.

WATTS, CAL.—The proposed bond election to be held in Watts, for voting on the question of issuing bonds in the sum of $85,000 for a municipal water system, and bonds in the sum of $15,000 for fire fighting and electric fire alarm system, will be held on June 17th, instead of June 7th.

RIVERSIDE, CAL.—By a vote of 5 to 1 Riverside voters have decided on municipal ownership of the city's domestic water. The bond issue of $1,160,000 for the purchases of three privately owned systems carried by a vote of 1893 to 418. Important improvements and extensions are planned

SAN JOSE, CAL.—The San Jose Water Company has applied to the commission for authority to issue $100,000 of short-term notes. The company desires to use the money for the following purposes: For the purchase of water rights from the Pacific Gas & Electric Company, $25,000; for payment of outstanding bills, $40,000, and for new construction, $50,000.

LOVELOCK NEV.—Water from the Pitt-Taylor reservoirs has been turned into the Humboldt River for irrigation of Lovelock valley. W. C. Pitt and John Taylor have for years been engaged in constructing the dams and reservoirs to store the waters of the Humboldt range for use during the irrigation season in Lovelock valley. The enterprise involves $400,000 and is the largest private irrigation scheme in the west. It has doubled the producing area of Lovelock valley.

SAN BERNARDINO, CAL.—A deal is pending between the Maclay Rancho Water Company and the Consolidated Securities Company of Los Angeles, under which the latter company is to take over all properties of the former company including lands, electric and water systems, water rights, and telephone system. If the deal is closed, it is likely that the new owners will put the local water plant in shape or either sell its water rights to the city of San Bernardino.

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE—Two steel tanks, 6 ft. by 12 ft., with convex heads; sheets ½ in. and heads ⅜ in. These tanks are new and only partially built. A bargain. San Francisco Disposal Co., Evans and Keith Streets, San Francisco.

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Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.

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American Ever-Ready Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
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Batteries. Storage
Edison Storage Battery Supply Co.
Electric Storage Battery Co.
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Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Western Electric Company

Batteries, Wet
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Western Electric Company

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Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

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General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
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Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

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General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Pass & Seymour, Inc.
Western Electric Company

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Benjamin Electric Mfg. Co.
General Electric Company
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D. & W. Fuse Company
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Western Electric Company
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Kellogg Swbd. & Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

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"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct,"National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

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Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

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Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
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Contactors, A. C. and D. C.
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Westinghouse E. & M. Co.

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Wagner Electric Mfg. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

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General Electric Company
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Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

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Fort Wayne Electric Works
General Electric Company
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D. & W. Fuse Company
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D. & W. Fuse Company
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Westinghouse E. & M. Co.

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General Electric Company
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Engines, Oil
Fairbanks, Morse & Co.

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Hunt, Mirk & Co.
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Johns-Manville Co., H. W.
Pacific States Electric Co.
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Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
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Filters, Oil
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Benjamin Electric Mfg. Co.
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American Ever-Ready Co.
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San Francisco, Rialto Bldg.

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San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
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"Century," Single Phase, R. J.
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Price Co., A. T. Egan.
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General Electric Co.
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Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
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Plugs, Attachment
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Plugs, Stage
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Western Electric Company

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Poles, Wood
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Fairbanks, Morse & Co.

Pumps, Centrifugal
Byron Jackson Iron Works.
Fairbanks, Morse & Co.

Pumps, Deep Well
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Vacuum
Simonds Machinery Co.

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Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
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JOURNAL OF ELECTRICITY

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Devoted to the Conversion, Transmission and Distribution of Energy

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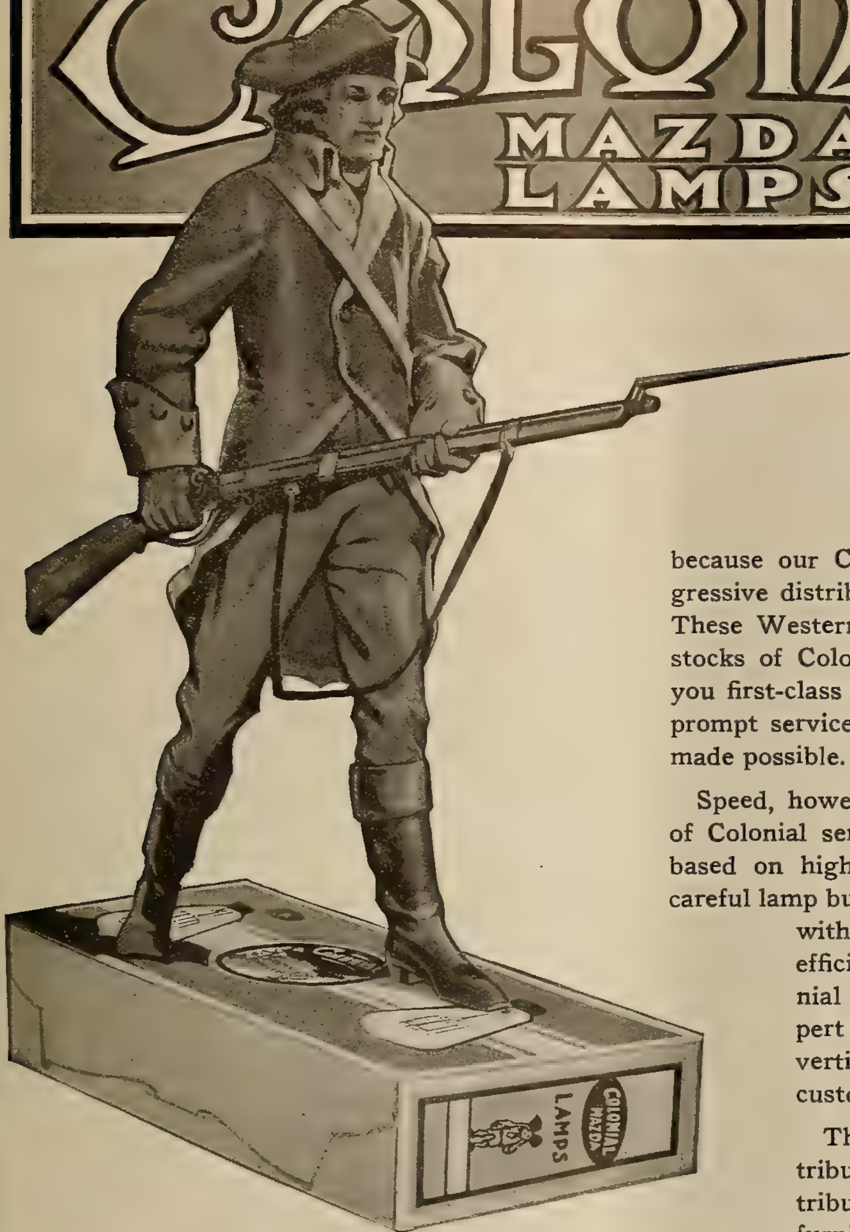

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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OREGON'S WATER POWER RESOURCES[1]

BY JOHN H. LEWIS.[2]

Celilo Falls on the Columbia River.

That iron and steel can be produced in the vicinity of Portland at a cost comparing favorably with Pittsburgh is not altogether an extravagant statement. The rapid perfection of the electric furnace, coupled with the presence of abundant and cheap water power, convenient rail and water transportation, and the anticipated influx of foreign labor with the opening of the Panama Canal, will bring about this desirable result.

Through the use of the electric furnace the poisonous gases emanating from the ordinary smelting and blast furnace operations will be almost completely eliminated and we will enjoy the advantages of a smokeless manufacturing city in a climate unequalled for the production of roses. It is estimated by Herbert W. Wilson that the smoke nuisance in the country as a whole causes an annual loss of $500,000,000 or $17 per capita for each man, woman and child living in large cities. Aside from this financial consideration, the solution of the smoke problem will be a leading factor in the future development of a manufacturing city.

A careful summary of available information relative to water power indicates that more than three million horsepower can be developed within economical transmission distance of Portland. In this respect, it is believed that no other city of its size in the world, similarly located on tide water can make such a showing.

The problem confronting Oregon is therefore to awaken such a strong public opinion with respect to the immediate development of this resource, that the necessary legislation can be enacted. This development can be accomplished without injury to posterity,

[1]Paper presented before Oregon Society of Engineers' meeting jointly with The Commonwealth Conference at Eugene, Ore., May 17, 1913.

[2]State Engineer.

as all water power franchises in Oregon are limited by law to forty years.

Development of Electric Furnace.

The development of the electric furnace has been phenomenal. In 1905, there were few in operation. In 1910, sixty were in use or under construction for various purposes and in 1912, Vom Baur published a list of 131 electric furnaces which are used exclusively in the iron and steel business, with 14 listed as under construction.

This phenomenal development can perhaps be appreciated better from the statement that the carbon electrode of such furnaces has increased in some cases to 30 in. in diameter and 10 ft. in length, as compared with those for the ordinary arc lamp which are but little larger than a pencil.

General View of An Electric Smelting Plant, Showing Smelter and Lime Kiln Building.

When all of the projects now under way in Norway and Sweden are completed, 250,000 tons of pig iron will be produced annually in the electric furnace.

These few statements should be sufficient to convince us that cheap and abundant water power is likely to prove as great an economic asset for the development of a country as the presence of cheap coal.

Electric Steel.

In the preface of a recent work translated from German, we find the statement that electric steel rails are found to be unbreakable in service when laid beside open hearth and Bessemer rails. With the latter scores of breaks have occurred in one season. The future of electric steel rails consequently seems assured. Electric steel castings have been on the market for the past four years and are looked upon with favor because of the high percentage of good castings and freedom from blowholes. The ability to make homogeneous tool steel, free from gases brought the electric furnace into commercial use about ten years ago.

Cost in Portland.

The cost of producing electric steel rails in the vicinity of Portland was estimated for the writer by Edward C. Potter, former superintendent of the Illinois Steel Company's plant in South Chicago. He states, under date of March 31, 1913, as follows:

"Considering the raw materials necessary, the supply of local iron ore does not exist in sufficient quantity or in economically available localities. Chinese iron ore, however, of a high grade has already been employed in the manufacture of steel on the Coast at a commercially economical price. It can be had in quantity and would be transported as a return cargo by ships transporting lumber and other commodities to the Orient, so that this could be relied upon as a source of supply. Moreover, there are vast quantities of high grade iron ore in Mexico contiguous to the Pacific Coast, which could be drawn upon for an indefinite period. The necessary carbon would be supplied by charcoal from the local forests, and limestone is everywhere available. These are all the raw materials required."

"At $9 per h.p. year for current and with the prices at which I know the various raw materials can be laid down at the proposed site of the plant, I have no hesitancy in stating that finished steel rails of standard weights could be there manufactured for $17.50 per ton. Standard open hearth rails are selling at $30 per ton at Chicago, which would mean approximately $40 per ton on the Coast, or let us say $35 per ton in the competitive territory from 500 to 1000 miles back from the Coast. Electric steel rails are commanding a premium of from $6 to $10 over open hearth rails, but assuming that the price of open hearth rails has to be met the proposed plant would be able to realize a handsome profit. The consumption of steel rails in the territory which would be tributary to the proposed plant would amount annually to fully 300,000 tons. This would require a plant capable of turning out 1000

Mammoth Electric Furnaces at Notoden, Norway.

tons of finished rails per day, which would be a plant of considerable size. There are also numerous other forms of steel which it might be desirable to manufacture and for which there would be a ready and a growing market. As to the technical and financial success of such a plant I have not the faintest doubt.

The Willamette Falls.

"As to the cost of Chinese ore, I know that it was delivered on the dock on Puget Sound for $4.50 per ton. This ore averaged 64 per cent metallic iron, making the cost just 7 cents per unit of iron which compares with about 8 cents for Lake Superior ore in Chicago."

At Heroult, Shasta county, Cal., 18 tons of pig iron are now being produced daily in the electric furnace at a cost of about $14 per ton, where the same grade at Pittsburgh costs $17.25 per ton. Freight to the Pacific Coast is given at $10.80, or a margin of $14 per ton in favor of electric iron on the Coast. Five additional furnaces are now being installed which will give a daily production of 120 tons of pig iron for this plant.

The approximate investment required for a steel plant in the East, capable of turning out annually 425,000 tons of Bessemer steel rails, including working capital, is between $23,000,000 and $33,000,000, according to the Commissioner of Corporations. As the capital cost of an electric steel plant is about one-third that of the old method such a plant for the Pacific Coast would require the investment of ten million dollars. It would consume about one million tons of iron ore and 330,000 tons of charcoal annually. As electric power is now being used in almost every department of the iron and steel industry, this plant would afford a market for approximately 150,000 continuous electrical horsepower.

Charcoal Industry.

The establishment of the iron industry in Oregon would greatly stimulate the lumber industry, as the waste from our saw mill and logging operations, which is now disposed of at a loss, could then be converted into charcoal at a profit. Mr. F. T. Snyder of Chicago believes that if electric energy was used in the distillation of this wood, enough by-products could be produced to make the net cost of the charcoal much lower than any other carbonaceous material for smelting purposes in Oregon. As it takes about two cords of fir wood to make one ton of charcoal, this incidental industry should prove of great benefit to the state, and afford an additional impetus for the development of water power.

Fertilizer from the Air.

The most important use to which our undeveloped water powers will eventually be put will doubtless be in the making of fertilizer from the air. The possibilities in this direction are almost inconceivable. Authorities estimate that all known deposits of natural nitrate fertilizers will be exhausted in about forty years.

A single company in Norway is now utilizing 200,000 horsepower in the manufacture of fertilizer from the air, giving employment to about 2,000 men. Over one-fourth of this company's product is said to be shipped to California and Hawaii in competition with the Chilean products. Bulletin No. 52 from the U. S. Department of Commerce and Labor states:

"It would require a capital investment of about $860,000,000 to assure the production of an amount of Norway saltpeter equal to that now consumed by the civilized world, assuming that sufficient cheap power were available."

As it takes about 1.6 horsepower year to produce

a ton of fertilizer, one million horsepower of that now going to waste in Oregon would furnish 625,000 tons of freight annually. This would go far towards maintaining regular freight service to all parts of the world.

Cost of Power.

In order that these various electric furnace industries may be established in Oregon, power must be delivered at from $9 to $15 per horsepower year, in comparison with $40 to $80, the cost of fuel power. At such low rates there can be but little, if any, profit in the electrical end of the business.

At Niagara Falls where the development cost was comparatively low, some power is now being sold as low as $9 per horsepower year. The limit of available power has however been reached and power prices are being advanced as old contracts expire. Most of the industries built up at that point are rapidly expanding and will have to seek new locations in the near future. These can be attracted to Oregon if we are in a position to furnish power at such cost as will permit them to live.

Public Development.

Senator Chamberlain recently introduced in congress a bill providing for the construction of a railroad in Alaska so as to make available for use the coal which is stored in this inaccessible region. Even when placed on the market at lowest possible cost, it is doubtful if this coal can compete with cheap water power in Oregon as Professor Richards of Lehigh University states that even in the Pittsburgh district it will be worth while for the iron and steel men to figure out in the near future, whether it will not pay to make pig steel direct from the ore in the electric furnace.

It would therefore seem more logical for the public to construct water power plants including necessary transmission lines, so as to make available for use the 3,300,000 horsepower now going to waste in the streams of Oregon. To produce this power in steam engines would require the burning of $144,000,000 worth of coal annually. In preventing this waste we are at the same time conserving the limited coal supply in Alaska for future generations. We might take a more active interest in the development of this power, if the streams were located in Alaska or some other inhospitable region, instead of at our very doors.

Water Power Policy.

Both the state and the nation have seen fit to impose heavy penalties on private capital seeking to put this power to use and have made no provision for its development with public funds. The state imposes an indeterminate tax, varying from 12½ cents to $2 per horsepower developed, the amount being adjusted from time to time by the state water board. Much of our undeveloped water power is located on property of the United States. This can be developed only under the provisions of a permit which can be revoked at will by the Secretary of the Interior. Both state and nation limit all franchises to the use of water for power purposes to a particular period.

Giant Schoenherr and Birkeland-Eyde Furnaces at Rjukan, Norway.

This restriction, however, is not as objectionable to private capital as the two indeterminate restrictions mentioned above.

In order to lessen somewhat this enormous waste of "white coal" it appears that we should do one of two things: either go backward and remove some of these restrictions so as to encourage development by private capital, or else go forward and make this resource available for use at public expense.

There is great confusion in both state and national laws relating to water, and capital is exceedingly slow to invest in large undertakings where the statute laws are not well supported by judicial interpretation. Furthermore, it will be some years before trade channels are fully established and the practical difficulties in the path of these new industries are fully overcome. Development by private capital will therefore be slow at best if each new industry to be established must also go into the electric power business, to insure a permanent supply of cheap power.

In Sweden, the rapid development of electrothermic industries is perhaps due largely to the fact that the government develops and furnishes power at low cost. For two years practically free power was granted the Iron & Steel Makers' Association, who constructed a $100,000 plant and carried on extensive experiments upon a commercial scale. The report of T. H. Norton to the U. S. Department of Commerce and Labor, October 16, 1911, shows these experiments to have been a success. Eugene Haanel states that advices from Sweden, dated April 29, 1910, show that 300,000 horsepower at Porjus will be developed soon, while another project of like capacity is in contemplation.

There is no doubt that such a policy pursued in Oregon at least during the experimental period, would bring about a much more rapid development than would be possible by private capital acting alone.

At the last session of the legislature a constitutional amendment, authorizing the issuance of state bonds for the construction of power plants, was submitted for a vote of the people in 1914. It is extremely important that the various organizations interested in the development of the state, study this question with a view to supporting or opposing such amendment. In this way an active and intelligent public opinion may be created which will result eventually in the enactment of some practical legislation to promote the early development of our water powers, having due regard to the rights of posterity.

USE OF ELECTRICITY IN NORWAY.

Probably more small towns and hamlets in Norway use electricity than in any other country, owing to the abundance of water power. In the country districts not only are there plants for each collection of five or six houses, but in many cases even small farms have their own generating plants.

In Christiana the electric plant, Kristiania Elektricitetsverk, is owned and managed by the city. The plant was built in 1891 by a German firm and cost $2,144,000, of which $1,340,000 has already been paid off from annual profits. The plant was originally fitted completely with German machinery, but one unit, lately added, was made in Norway.

All current consumed in Christiania is sent out from the city plant, but only about one-third of it is generated there. The city purchases 6500 kilowatts of alterating current from the Kykkelsrud Company, which generates electricity from the waterfalls at Kykkesrud, 40 miles from Christiania; 1950 kilowatts of alterating current are obtained from the city's plant at The Hammer waterfall, in the Maridalsvand or Maridals Lake district, 7 miles from here; and about 4000 kilowatts are generated at the city plant by steam. Of the 4000 kilowatts, 2400 are alternating and 1600 direct current, but it is all transformed to direct. The direct current is used in the center of the city and the alternating, which is 50 cycles per second, in the less congested parts and in the suburbs. The voltage used is 230 volts. Both currents are supplied night and day.

In 1911 meters were used by 4536 people, while 11,794 were charged a contract price for so many watts, an automatic cut-out, furnished by the company, "blinking" the current, or turning it off and on, until the amount used is reduced by turning off some lamps. The total current used in this same year, 1911, was about 10,000 kilowatts, of which 3859 was direct current and the balance alternating. Of the latter, 1346 kilowatts were furnished the street-car companies.

Notwithstanding the large profit made by the city, current is furnished consumers at very low prices. For lighting purposes the rates, per kilowatt hour, during the last 10 years, have been as follows: 1902 and 1903, 13.4 cents; 1904, 10.72 cents; 1905 to 1910, 8.04 cents; 1911, 6.97 cents. For technical purposes the rate has always been the present one, 5.36 cents per kilowatt hour. On contracts the prices are even lower. Thus, the lighting rate is $5.36 per 100 watts per year and rates for technical uses are $24.12 per horsepower up to 15, and $18.76 per horsepower if more than 15 horsepower is used.

In the other cities and in the country districts the rates are also very low. Alternating current, generated from water power, is usually used. The machinery in general is of German manufacture as are, also, the lamps and copper transmission lines, cut-outs, meters, etc. Some of the plants are owned by the communities and others are privately owned.

GATUN HYDROELECTRIC PLANT.

Excavation for the foundations of the hydroelectric station at Gatun spillway, which will generate electricity for all of the operating machinery and lights of the Panama Canal, is practically completed. The erection of the three penstocks was about 95 per cent completed on May 1. All of the turbo-generator sub-foundations are in place, three water turbines have been installed, and the erection of the turbogenerators is about 45 per cent completed. All of the structural steel for the station building has been received. All line construction material for the Cristobal-Balboa electric transmission line is now under contract, with deliveries promised in about four months. It is expected to award contract for the substation equipment shortly. Construction work on foundations has been started at New Culebra Siding.

ELECTRICAL PUMPING AND IRRIGATION

REINFORCED CONCRETE PIPE.

BY B. A. ETCHEVERRY.

Reinforced concrete pressure pipes depending entirely on the concrete to prevent percolation have been used successfully for heads as great as 100 ft. and are guaranteed by some pipe manufacturers for pressures as great as 150 ft. By using a metal shell either as a lining or imbedded in the concrete they are used for heads above 300 ft. For pressures as great as these the work must be carefully done. The pipe consists of a skeleton of iron or steel imbedded in a concrete shell. The metal is designed to take the entire tensile stress due to water pressure and water hammer. The concrete serves as a protection to the steel and is made only thick enough to give the pipe rigidity and prevent percolation.

Reinforcement of various kinds is used for pipe construction. Those most generally used are round steel rods, corrugated bars, twisted bars, expanded metal, metallic cloth, etc. Two French constructors use special bars in the form of small I beams and crosses claiming for them greater rigidity and strength.

The circumferential reinforcement is the most important as it takes up the entire stresses due to water pressure and water hammer. The safe working strength of the reinforcement is usually taken as 12,000 to 16,000 lbs. per sq. in. The longitudinal reinforcement is used either to hold the circumferential reinforcement or to resist temperature stresses due to contraction. When the pipe is built in sections, or if expansion joints are provided, little longitudinal reinforcement is necessary. When the pipe is built continuously the amount of reinforcement will depend on the extremes in temperature. To reduce the contraction when feasible it is advantageous to construct the pipe at a low temperature and to cover the pipe when constructed with an earth covering. An amount of reinforcement to resist temperature stresses of .2 to .3 per cent of the concrete area is generally sufficient.

The circumferential reinforcement for pipes of smaller diameter is wound by machinery in the form of a spiral and kept to the proper spacing by means of longitudinal rods tied to the spiral with wire. For large diameters of pipes and for heavy reinforcement, which cannot be wound in spiral, the steel is bent into hoops by means of rolls. The ends of the hoops are either lapped and tied together with wire, welded, riveted, or each end is bent into a hook and a longitudinal rod passed through the eye of the hooks. When the pressure is from the inside the longitudinal reinforcement is placed on the inside of the circumferential reinforcement, and for exterior pressure it is placed on the outside. Frequently for interior pressure the reinforcement is placed nearer the outside of the shell and for exterior pressure nearer the inside. M. Bonna, a French constructor, does not rely on the imperviousness of concrete for heads above 50 ft. and uses in addition to the ordinary reinforcement a thin steel shell, placed as a lining inside the pipe or imbedded in the concrete between two reinforcing skeletons.

Concrete proportioning must be accurately done to obtain an impermeable pipe. The mixture must be rich. The Reinforced Concrete Pipe Company of Los Angeles uses a 1 : 2 : 4 mixture for 25 ft. head and 1 : 2 : 3 mixture for heads from 50 to 100 ft. On the Umatilla project, Oregon, the mixture varied from 1 : 1.8 : 3 to 1 : 2 : 4. On the Belle Fourche siphons, South Dakota, it was 1 : 2¼ : 3¾ and on the Albelda siphon, Spain, it was 1 : 1.28 : 2.56.

The reinforced concrete pipes may be of two different kinds, depending on the method of construction. They may be constructed:

1. By casting the pipes in short lengths, then laying them and joining the sections.
2. By constructing the pipe in place in the trench,

The second method is generally used for larger conduits and requires a thicker shell, the minimum thickness being about 5 to 6 in.

Reinforced Concrete Cast Pipes.

The pipes are made by this method up to diameters of 6 ft. and in some cases greater. The sections may be as much as 10 or 12 ft. long. The thickness

Metal Mould for Casting 47-in. Reinforced Concrete Pipe, Umatilla Project—Oregon.

of the shell seldom exceeds 2¾ to 3¼ in. and smaller pipes under 9 inches in diameter are made 1½ to 2 in. thick.

The method generally used is to mould the pipes vertically by placing the steel skeleton between the forms and filling the mould with concrete. The method used on the Umatilla project in casting one size of pipe is typical and is as follows:

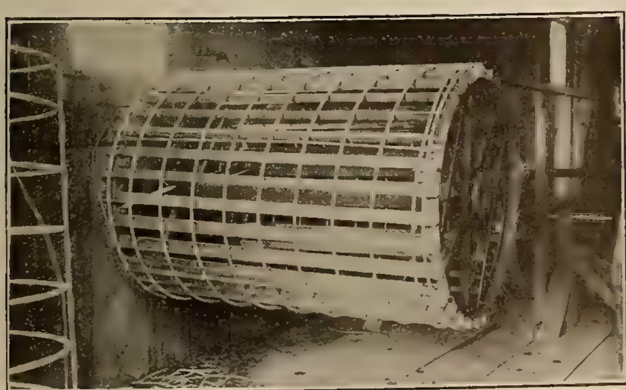
The pipe is 47 in. inside diameter, 2½ in. thick, and 8 ft. long. The moulds consist of an interior collapsible form 8 ft. long made of steel plate ⅛ in. thick in two main parts bent on a 47 in. radius and hinged to a vertical joint 8 ft. long. The core is made collapsible by a third part consisting of a closing piece 8 in. wide and 8 ft. long, which with the other two pieces complete the inside circumference of the pipe. The outside form is made up in four sections, 2 ft. high, and each section is made of three parts, each part being 1/3 of a circumference and 2 ft. high. This form is made of ⅛ in. steel plate strengthened with

2x3x3/16 in. angles riveted to the edges of each of the 12 parts. The rivets are countersunk on the inside. The parts can all be bolted together. The base ring is of cast iron and gives the base of the pipe the proper shape. The reinforcement, which consists of round wire, is wound into spirals 4 ft. long, two spirals being used for the pipe 8 ft. long. The machine by means of which the spirals are made consists of a reel. On this reel are spacing bars with notches in which the reinforcement is placed when winding. Longitudinal rods 4 ft. long are placed on the outside of the reel and hooked to the reel at the two ends and the spiral and longitudinal rods are tied together with

Moulds for Casting 30-in. Reinforced Concrete Pipe, Umatilla Project—Oregon.

wire. After the spiral has been wound and tied to the longitudinal rods, the spacing bars which are hinged on the frame are folded over and the spiral removed. Then the spiral is made more rigid by cross lacing with wire.

The method of moulding is as follows. The moulds are well oiled and the base ring placed on the ground. The interior is placed in position and the reinforcing skeleton placed around the inside core. Then the lowest section of the outside form which is formed of the three parts bolted together is placed around the skeleton. The base ring gives the proper



Reel for Forming Spiral Reinforcement for Reinforced Concrete Pipe, Umatilla Project—Oregon.

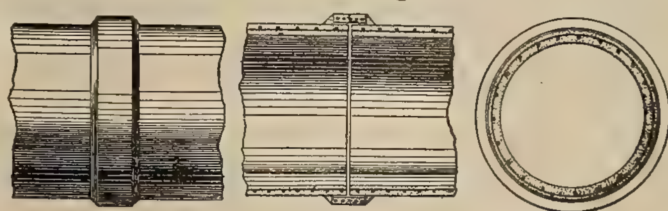
spacing to the inside and outside form. The concrete is machine mixed and consists of 1 part of Portland cement, 1.8 parts of sand, 3 parts of gravel with enough water to give a wet concrete. The concrete is placed in the moulds and well stirred and worked down with thin tamping rods. When the first section of the mould has been nearly filled, the other sections are bolted in succession, each being filled nearly to the top before the next one is put on. To fill the fourth section, a funnel shaped collar is placed around the inside core and bolted to the outside core. When filled, the collar is removed and the upper end of the pipe finished by hand. The forms are removed two hours after the pipe has been moulded and the base plate is left for eight days. For the 30 in. reinforced pipe the forms used are 4 ft. long and made of lumber lined with sheet steel. The interior core consists of two main parts and a third part or closing piece. These may be fastened together so as to be rigid. The outside form consists of four parts which are bolted

Joints.

The pipes after they have hardened sufficiently are placed in the trench where they are joined. If praticable, the best time to lay the pipe is in cold weather for a rise of temperature will reduce expansion and make the joints tighter while if they are laid in the summer time any contraction due to lowering of the temperature will tend to produce shrinkage cracks. The joints may be made in three ways: (1) bell and spigot joint; (2) collar joint; (3) lock joint.

The bell and spigot joint has been used on smaller pipes where the pressure is not great. On the Umatilla project some of the 30 in. pipe has been laid under a pressure head of 23 ft. with this type of joint. The pipes are similar to the non-reinforced pipe described further and have a taper end and a bell end, the joints being made in the same manner as the joints for non-reinforced pipe.

The collar joint is the method generally used in Europe and the method used for the larger pipes on the Umatilla project in Oregon. The joint is made by a reinforced collar from 4 to 8 in. long whose interior diam-



Collar Joint for Reinforced Concrete Pipe.

eter is slightly larger than the outside of the pipe. The collars are reinforced in the same manner as the pipe.

The ring is slipped over the pipe last laid in the trench and the next pipe is laid in position. Some prefer to leave a space of ¼ to ¾ in. between the ends of the pipe and to fill this space with cement mortar. Then the collar is placed over the joint. Both sides of the collar are stopped with mortar and through two holes in the collar a cement mortar in the form of grout is run in and fills the space between the interior of the collar and the outside of the pipe. For the 47 in. pipe on the Umatilla project the collar was made in three parts. Each part is shorter than 1/3 the outside circumference of the pipe but the circumferential reinforcement in the collar projects beyond the end of each part so that when the three parts are placed around the joint the reinforcements overlap and the collar is completed with cement mortar. The collar is 3 in. thick and 4 in. long, reinforced with two 5/16 in. rods.

LOCATING FAULTS IN UNDERGROUND CABLES

THE VARLEY LOOP TEST—IV.

BY C. A. GAINES.

Where one good conductor, for completing the cable loop, cannot be found in the cable under test, and another conductor of the same length and of the same size is not available, the Murray loop method of testing becomes more difficult. In fact, when a regular Wheatstone bridge test set is used the Murray loop method loses some of its simplicity and there is little advantage in its use, and the more accurate Varley loop test should be used.

As in the Murray test the Varley test also depends upon the formation of a loop with one good conductor and the faulty one, although it is not necessary that the two should be of the same size, nor of the same length.

By placing a known resistance in series with the faulty cable, R in Fig. 1, the Murray loop set up becomes the Varley loop and it is then possible to determine the actual resistance of the cable. It should be noted in the test described above that we do not deal with the actual values of the resistance of the cable under test, but with the ratio of these resistances. In the Varley loop test we obtain the resistance of the entire faulty conductor in ohms and the resistance in ohms of the conductor as far as the fault and then the ratio of these resistances is taken to give the ratio of the distances. This means that in using this method several tests must be performed in order to obtain the different resistances and that each of these tests requires a certain amount of calculation in addition to the final calculation when the results of the several tests are combined. But as the actual values of the resistances of the conductors under test

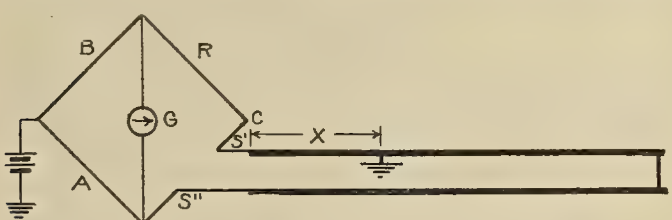


Fig. 1.—Measuring Resistance of Cable to the Fault.

are obtained, any irregularity in the connections or an abnormal value for the conductor resistance is readily detected. It sometimes happens that the burnout in a cable may introduce 10 or 15 ohms into the resistance of the faulty conductor, a fact which would not be detected by the usual method using the Murray loop.

As the most simple fault to locate with this method of testing is a ground on one conductor, with the two remaining conductors of a triplex cable in good condition, the application to such a fault will be first described and then mention will be made of some of the changes necessary to adapt it to some of the other conditions which may arise.

After first determining that such a condition exists, connect the two good conductors to the faulty conductor, taking care that the two connections do not touch one another, as in Fig. 1. If this precaution is taken, the resistance of the connections at this end of the cable will not appear in the final results.

If the battery connection to ground in Fig. 1 is removed and attached to "C," as in Fig. 2 we have the usual Wheatstone bridge set up for measuring a

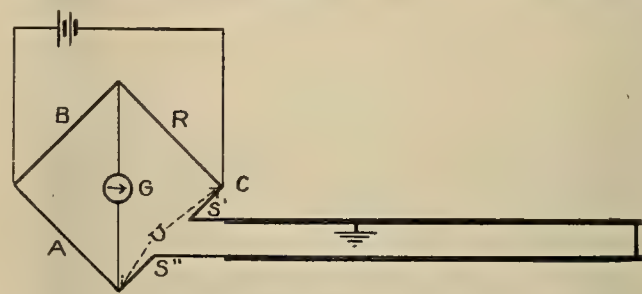


Fig. 2.—Measuring Resistance of Loop U.

resistance and in this case when the galvanometer is no longer deflected upon closing the battery and galvanometer keys $\frac{AR}{B} = U$, the resistance of the entire cable loop with the two leads S′ and S″.

If the battery is now removed from C and connected to the earth as in Fig. 1, a balance will be obtained when

$$B/A = \frac{R + S' + X}{U - (S' + X)}.$$ From this equation we get

$$X = \frac{BU - AR}{A + B} - S'$$

By changing the battery connections to the other good conductor (Fig. 3) we can obtain the resistance W of the entire faulty conductor by the same method

$$\text{and } W = \frac{BU - AR}{A + B} - S'$$

It should be noted that in this case by keeping the connections at the far end of the cable separate

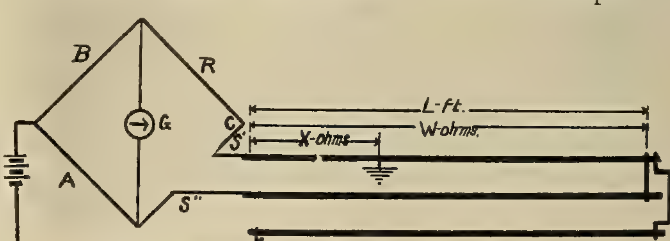


Fig. 3.—Measuring Resistance of Entire Faulty Conductor.

from one another the battery current is taken into the faulty conductor in such a way that all the resistance of the connection to the other good conductor becomes a part of the arm attached to arm "A" of the bridge. W, S′ and R constitute the other arm of the bridge and are entirely independent of

the connections at the far end of the cable. The connection between the battery and the faulty conductor to some extent controls the amount of current delivered, but does not affect the balance obtained between the different resistances and so the battery connection does not require the same care that should be given the connections which enter into the loop.

It now becomes necessary to find the resistance of the lead S′. If the connection to the cable conductor is sufficiently secure so that one may be safe in neglecting the contact resistance, the value of the resistance of S′ may be found by disconnecting from the cable and by determining this resistance by simple Wheatsone test.

If there is any question about the contact to the cable conductor care should be taken that the connection is not moved during the entire test and the Varley loop test can again be used, by attaching the

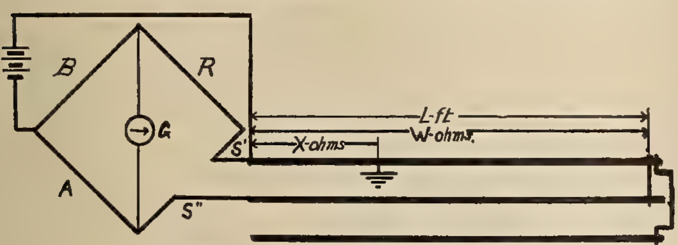


Fig. 4.—Switchboard Voltmeter.

battery connection to the faulty conductor near to but not touching S′. See Fig. 4.

When a balance is obtained $S = \dfrac{BU - AR}{A + B}$

Substituting this value of S′ in the equations for X and W, they can be solved and then the ratio X/W gives the ratio between the distance to the fault and the length of the cable, or $\dfrac{XL}{W}$ in ft. = distance to the fault in feet.

If a short should develop in a cable instead of a ground, one of the defective conductors will be used as part of the loop and the other faulty conductor will take the place of the ground connection in the above test. The earth can be sometimes used for the battery conductor in determining "W," but never use the earth as part of the loop for two very important reasons. First—The resistance of the connections to ground cannot be depended upon to remain constant, and second—stray currents in the earth will destroy all accuracy of resistance measurements. For these reasons the earth is used in the loop tests only for the battery connection.

With two or three conductors of a triplex cable both shorted and grounded, a fourth conductor will be needed in using the above method of determining W. Almost as good results can be obtained without this fourth conductor by using the following method.

In Fig. 5 E and F are the two conductors which are shorted and grounded, and G is a good conductor which need not be of the same size nor of the same length as E or F. Connect E and G (Fig. 3) and measure the resistance of the loop EG. Call this R. Change the connection from E to F and measure the resistance of the loop FG, calling this R_2. Then connect E and F in multiple and the combination in series with G (Fig. 4) and measure the resistance R_3.

If $R_1 = R_2$, then E or $F = 2\ (R_1 - R_3)$. If R_1 differs from R_2, then the equation

$$e\ E = R_1 - R_3 + \sqrt{R_8\ (R_3 - R_1 - R_2) + R_1 R_2}$$

can be used to solve for the resistance of the faulty conductor. This equation is obtained by solving for E from the three following equations.

$$E + F = R_1$$
$$E + G = R_2$$
$$\frac{1}{\dfrac{1}{E} + \dfrac{1}{F}} + G = R_3$$

The writer remembers one case where all three conductors of a 300,000 triplex were shorted and grounded and the fault was located by finding the resistance of one conductor to the fault and then calculating the length of the copper conductor which would have that amount of resistance. The particular difficulty which was encountered in this method of testing was to find the resistance of the conductor to the fault without including the resistance of the fault. Measuring the resistance of the conductors in pairs the following values were obtained:

E to F = .42 Ohms
F to G = 55.80 "
E to G = 55.80 "

It is evident from these values that E and F have a very low resistance short for the two resistance of F to G and E to G could be equal only under two conditions. Either the resistance of the short between

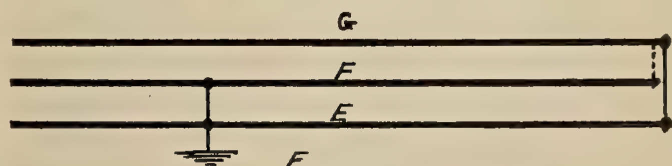


Fig. 5.

E and F is negligible as compared to 55.8 ohms, or else the connection between G and the other two legs happen to come midway in the connection between E and F. See Fig 5.

The probabilities of such a balanced connection occurring in a short are very remote, and it was therefore assumed that the first condition was true and that E and F were solidly connected at the short, and therefore the resistance of one conductor as far as the fault was $\dfrac{.42}{2}$ S′ or .21 — S′ Ohms. After correcting for the leads the resistance of the conductor alone was found to be .19 ohms, and the fault was then located by the equation

$$Z\ \ X = \frac{.19 \times 300{,}000\ \text{CMS}}{10.37} = 5500\ \text{ft.}$$

The use of 10.37 as the resistance of one mil. foot of copper assumes that the average temperature of the cable is approximately 68 degrees F., and in this case the results justified that assumption.

It is very seldom that one case of fault locating is similar to another case, and it is therefore impossible to make any detail set of rules for procedure in hunting trouble. Too much stress cannot be laid on the necessity for care in first determining what kind of a fault exists. Determine the character of the fault before attempting to locate it.

It is not always necessary to use all the refinements given above. The conditions under which the test is made will determine which ones can be omitted. For instance, if the resistance of the three loops AB, BC, and AC, in a three conductor cable are equal, it is safe to take one-half the loop resistance for the resistance of one of the conductors. But when connections are made under unfavorable conditions it is not safe to assume anything which can be determined by test.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S ANNUAL REPORT.

The board of directors of the Westinghouse Electric & Manufacturing Company has submitted to the stockholders the following report of the operations of the company and of its subsidiary companies, under date of May 20, 1913, for the fiscal year ending March 31, 1913. The income account for the year is as follows:

GROSS EARNINGS:		
Sales billed		$39,977,565.89
COST OF SALES:		
Factory cost, including all Expenditures for Patterns, Dies, New Small Tools and Other Betterments and Extensions: also Inventory Adustments and all Selling, Administration, General and Development Expenses		35,406,293.69
NET MANUFACTURING PROFIT		$ 4,571,272.20
OTHER INCOME:		
Interest and Discount	$ 294,887.22	
Dividends and Interest on Sundry Stocks and Bonds Owned	647,908.46	
Miscellaneous—Royalties, etc.	53,768.20	996,563.88
GROSS INCOME FROM ALL SOURCES		
DEDUCTIONS FROM INCOME:		
Interest on Bonds & Debentures	$1,103,423.77	
Interest on Collateral Notes	409,672.34	
Interest on Long Term Notes and Mortgages	99,319.32	
Depreciations Charged Against Income	606,128.73	
Proportion of Expenses Incidental to Bond and Note Issues	90,000.01	
Miscellaneous	95,259.66	2,403,803.83
NET INCOME AVAILABLE FOR DIVIDENDS AND OTHER PURPOSES		$ 3,164,032.25
PROFIT AND LOSS CREDITS:		
Profit and Loss—Surplus, March 31, 1912	$6,648,964.29	
Profit on Bonds Purchased	1,747.40	
Adjustment of Appraised Values of Property and Plant Accounts	27,220.51	
Miscellaneous	90,238.97	6,768,171.17
GROSS SURPLUS		$ 9,932,203.42
PROFIT AND LOSS CHARGES:		
Dividends on Preferred Capital Stock	$ 279,909.00	
Dividends on Common Capital Stock	1,053,665.60	
Depreciation of Investments	966,919.56	
Miscellaneous	283,187.12	2,583,681.28
SURPLUS, MARCH 31, 1913, per balance sheet		$ 7,348,522.14

The value of unfilled orders as of March 31, 1912, was $8,137,961; as of March 31, 1913, the value of unfilled orders was $12,061,473. The average number of employes during the year was 20,542, as compared with an average of 16,000 for the previous year.

The surplus as of March 31, 1912, was $6,648,964.29. This balance was increased by the net income for the year and various items detailed in the statement of profit and loss, to a gross surplus of $9,932,203.42. Against this surplus have been charged dividends declared during the year, on the preferred stock at the rate of 7 per cent per annum ($279,909) and three dividends of 1 per cent each, aggregating $1,053,666, on the common stock, also miscellaneous charges totaling $283,187.12. These charges reduced the surplus to $8,315,441.70, against which depreciations of investments aggregating $966,919.56 were written off, leaving the surplus as of March 31, 1913, shown in the balance sheet, $7,348,522.14.

So far as your foreign companies are concerned, while further depreciation is possible in some of them, it will probably be more than offset by the appreciation of others; so that, after the final adjustment resulting from liquidation of the Russian company, it is believed that, under existing conditions, their aggregate book value will be a fair actual value.

Property and Plant, $20,467,224.74. The increase in this item of $1,272,036.68 over the figures as of March 31, 1912, after deducting liberal depreciation charges, represents necessary purchases of additional manufacturing equipment chiefly at the East Pittsburgh and Newark works and the erection of additional buildings at East Pittsburgh on real estate already owned. No purchases of real estate were made during the year.

A further extension was obtained of the lease of the property on which your company operates an iron foundry at Pittsburgh, Pa.

Securities of W. E. & M. Co. The increase in securities of your company held in the treasury is chiefly due to the receipt from the trustee of $686,000 face value convertible sinking fund gold bonds, in accordance with the provisions of the bond indenture, and to the purchase of $150,000 face value of debenture certificates due July 1, 1913. The bonds are held in the treasury for sale or use for sinking fund purposes, and the debenture certificates will be delivered to the trustee for cancellation on July 1, 1913, on which date the entire outstanding balance of the issue of debenture certificates will mature.

Foreign Companies. During the year the Canadian Westinghouse Company, Limited, made an issue of additional capital stock, to which your company subscribed for its pro rata amount, $243,400, at par, all of which has been paid for excepting $60,850, due under the terms of subscription on May 1, 1913.

Current Assets—$18,126,991.53.

The amount of reserve for notes and accounts receivable as of March 31, 1913, is believed to be sufficient to provide for any probable shrinkage in the book value thereof, with the possible exception of a note of the Security Investment Company, to which reference was made in your director's report for the year ended March 31, 1911.

Advances to Foreign Companies.

During the year the following advances were made to foreign companies on notes and open account:

Russian Company $454,155. As noted elsewhere, this company is now in process of liquidation, and your company should eventually recover all advances made since the receivership.

French and Italian Companies $275,032. This advance was made for the purpose of assisting the Italian company in financing a recent order for locomotives received from the Italian government, to which reference is made elsewhere.

Austrian Company $225,508. This advance was necessary to enable the Austrian company to produce and market drawn wire tungsten lamps, which type of incandescent lamp is rapidly replacing the old type of lamp throughout Europe.

French Lamp Company $50,000. While the stock interest of your company in the French Lamp Company is small, being less than $40,000, its affairs are so complicated with your other interests in Europe that this advance was necessary, also on account of the introduction of the drawn wire type of lamp. Definite plans for dealing with this company have been formulated.

Working and Trading Assets—$18,510.222.56. A large increase in these assets over the value as of March 31, 1912, was to be expected in view of the increase in shipments billed during the year as compared with the previous year, and the increase of approximately $4,000,000 in the value of unfilled orders on hand as of March 31, 1913, as compared with the close of the previous year. The usual annual inventories of all raw materials, finished stocks and work in progress were taken and valued as purchase prices or manufacturing cost, or less. A fixed basis has been established for the depreciation of inactive stocks.

Other Assets—$7,011,528.36. The total of this item again shows a decrease as compared with the previous year. The amount of the expenditures for patents capitalized during the year was $26,381.70, all additional expenditures for patents and licenses and the cost of all development and experimental work having been charged to operating expenses.

Liabilities.

The changes in the funded debt of the company as of March 31, 1913, as compared with March 31, 1912, have been explained in the comments pertaining to sinking fund and investments. The outstanding balance of debenture certificates matures July 1, 1913, and is expected to be provided for by the sale of convertible sinking fund bonds of an equal total face value that under the terms of the bond indenture were reserved to retire them. The four-year notes issued under the plan for the discharge of the receivers of your company, matured January 1, 1913, and were paid.

During December, 1912, and March, 1913, your company borrowed with treasury securities as collateral, $3,500,000 on notes maturing in June and September, 1913. On August 1, 1913, the issue of $4,000,000 three-year collateral notes made August 1, 1910, will mature. Your directors have under consideration plans to provide for these maturities which it is expected will effect a considerable reduction of the total.

The acknowledgment of the board is hereby made to the officers and employes of the Westinghouse Electric & Manufacturing Company and its several subsidiary companies for their devotion to the company's interests and efficient services rendered during the year.

ANALYSIS OF SALESMANSHIP AND THE DEVELOPMENT OF SALESMEN AS APPLIED TO THE ELECTRICAL SUPPLY BUSINESS.[1]

In presenting a paper on these subjects, I appreciate the fact that it may not be proper to treat them under the same heading, but as they rightfully apply to the question of salesmanship, I would take the liberty of treating them as one subject, and hope in this way to point out not only a means of training men to the point that they are ready to enter the sales department, but offer a few suggestions for their guidance before taking up this branch of work.

The average employe in a supply organization does not appreciate what salesmanship really is and this is demonstrated by the number of men who are constantly striving to get into this branch of the business. Without considering for a moment their duties, responsibilities and obligations to the firm, they do not hesitate to make application to the sales department and very often those connected with supply institutions are inclined to place men in this branch, who, even though they may possess all of the other qualifications necessary for the make-up of the successful salesman, lack the technical and practical knowledge which is essential to their success.

I think we will all agree that the electrical supply business of today demands more of its employe than in any other merchandising line, and this is tenfold apparent when applied to salesmen.

The average man cannot learn his line thoroughly, even though he devotes half his lifetime to its study for the reason that there are not only a great many devices to handle, but the same devices under different conditions become entirely different articles, notwithstanding the fact that the popular selling articles of today are relegated to obsolete stock a few months hence.

Those of us who were fortunate enough to get into the business in its early stages, and have grown up with it, hardly realize what is expected of the average young man of today when he enters this field.

I believe that a great number of the failures of electrical supply salesmen may be attributed to the men who employ them, as the applicants know very little of the task they are about to undertake and do not realize what is expected of them. Therefore, my conclusions are that one of the most difficult problems is to select the proper man.

One cannot become a successful salesman simply because he knows his line from the practical side; for there are many other qualifications of equal importance. He must possess considerable knowledge of the technical end of the business, be a good correspondent, a good student of human nature, not only be a good talker, but have good control of his conversation, his temper and deportment, in order that he may perceive in an instant when he is on the wrong track. He must maintain his dignity under the most trying circumstances, possess tact and initiative, understand the application of suggestion to salesman-

[1]An address given by Mr. W. L. Goodwin, before the Pacific Division of the Electrical Supply Jobbers' Association at Del Monte, Cal., February 28, 1913.

ship, be aggressive and enthusiastic and last, and of prime importance, be loyal.

Now, without considering any of these qualifications in detail, we would immediately conclude that it is absurd to assume that any human being could possess all of these characteristics, and further, that they are not essential to the make-up of a successful salesman.

Now, let us analyze these points before drawing this conclusion and we will find a few reasons why we dismiss men from our employ after they have actually been assigned sales work, provided we have not given these points previous consideration.

First, technical knowledge of the business is necessary, as our men are constantly brought in contact with engineers, who, having been trained in the technical end of the business, will not, as a rule, tolerate a salesman who does not possess a knowledge of the law of electricity — $E = IR$; who does not know the difference between alternating and direct current, between a series and a multiple system, a grounded or metallic circuit and a thousand and one other essentials which may be listed under this heading.

Without argument we must agree that he must be able to compose a letter that will reflect credit to the organization. If he is not a judge of human nature, he cannot detect, when approaching a buyer whether the occasion is favorable or unfavorable for pressing his case, and naturally, does not know when to withdraw, leaving the way open for a future engagement.

Unless he is a good talker, he cannot impress his listener. It is the quality of talk that counts. It is not what a man knows, it is what he thinks he knows that he talks too much about. The right thing to say at the right time closes many a deal, while the reverse has lost many an order. It is said that the true salesman comprises nine parts judgment and one part talk, using the nine parts judgment to tell when to use the one part talk.

Temper, deportment and dignity need no explanation. The lack of either would be a vital failure in a salesman.

Tact includes intelligence, reserve, and all the other qualities that enable a man to adapt himself to circumstances. From the time of introduction, until you part, tact is winning or losing for you.

Discrediting your competitors shows lack of tact and is the basis of many lost orders, yet never mentioned in the salesman's lost order report.

If it were not for initiative, a salesman would be a parrot and we have no place in our business for parrots. The world reserves all of its big prizes for one thing, and that is initiative. Initiative is doing the right thing without being told. Next to doing the thing without being told is to do it when you are told once.

Admitting that there is a field for suggestion in sales work, why should a salesman be possessed of this quality? You must consider the mind of the customer and the successive conditions to be produced in it, as there is no doubt that the sale takes place in the mind.

In order to make your sales you have to induce people to buy. You, therefore, must command their attention and this can be accomplished partly by suggestion. The power of suggestion enables you to make the buyer listen after you have really engaged his attention, forget other things, be oblivious to all else but yourself, what you are saying, and what you have to sell.

Aggressiveness and enthusiasm, combined with all the other qualities, carry the salesman to his proper level. Without both of these qualities, he cannot progress. And last, loyalty; if there is any one quality that is essential to an employe, and particularly to salesmen, it is loyalty. The salesman is the representative of the house who meets the public and naturally he is the prey of the dissatisfied buyer, who soon learns to take advantage of the disloyal salesman. Under the most trying circumstances he must at all times defend the reputation of the house. I do not want a salesman who is not loyal, even though he possesses all of the other qualifications. The physical, as well as the moral effect, is bad. If I have lost confidence in him, I find myself withdrawing my support from him. If such a suspicion arises, I have it out with him, and if the traits of disloyalty continue, the quicker he leaves my employ, the better.

A salesman who is loyal, and possesses only a fair knowledge of business, with a touch of all the other qualities, is worth more in my mind than the one who could be measured 100 per cent in every other quality, but is lacking in loyalty.

Having covered the main points of character, what other qualifications should a salesman possess in order to hold his place in these days of strenuous competition?

He should be thoroughly familiar with the policy of the house—know his price book like he knows his ABC's; have a knowledge of the stock carried, the nature of the order he receives, the time it requires to assemble and ship it, in order that he will not make unreasonable promises which the house cannot fulfill.

He must be able to enlist the co-operation of the men on the inside. One of the duties of the salesman, and one which is seldom used by him, is the privilege of calling upon any or all the departments of the company when necessary to close the sale. The salesman usually does not realize the amount of power he controls in the hollow of his hand. He should not be afraid to call for help.

One weakness of the salesman of today is lack of confidence in his price book. As selling is an art, so is buying, and while the salesman is straining every point to land the order, the buyer is just as keen to purchase at a low price and never loses an opportunity of telling the salesman how much lower he can buy from his competitor.

I find that by compelling the salesmen to render reports of all business lost, and by properly classifying and filing the reports, going over them at reasonable intervals, and pointing out to the salesmen that they cannot obtain all the business and that a reasonable number of lost orders must be expected, enlists the confidence of the salesmen and encourages them to stand pat on prices. A salesman should not be brought to task for a lost order unless it can be clearly shown that the order was lost through his negligence. Try

to point out the real reason and in that way he is encouraged to further effort in the future.

The handling of salesmen is in itself a big subject, and I will not attempt to treat it in detail in this paper. I believe, however, that while the salesman is entitled to the full co-operation of the entire organization, he must not be given to understand that the sales department is the entire company. He should be compelled to observe and maintain the same hours and rules as the other employes and be restricted in his expenditures.

The granting of special privileges to salesmen as to conduct, or otherwise, is liable to create dissension among the other employes and lack of co-operation is the result.

Now, let us analyze who may be considered a salesman. The butcher and baker who travel around the country crying their wares are not salesmen, but peddlers, supplying necessities and securing their business through convenience of the buyer.

The man behind the counter knows the location of the wares, submits them for inspection and depends upon chance. He is a stock clerk.

The young and inexperienced man goes on the road with a prepared list of established goods and gets orders that would otherwise be mailed to the house. He is a fledging accident.

The old traveler depends upon acquaintances or personal friendship and favoritism. He is a "has been."

But when a man takes a new and untried article, studies its merits and selling qualities, becomes enthusiastic as to its possibilities, introduces it to his trade, finds users, creates interest, sustains the interest and creates a desire, turns desire into determination to buy his goods, secures confidence of his customers and gets the order; in fact, creates a market and supplies the demand, he calls himself a salesman, and he is. He is a producer and a diplomat. He sells by a scientific method and that is what salesmanship is today; a science.

With our increasing business, due to the rapid advancement of the art, men must be added to the selling force, not only to take care of the natural growth of the business, which will come, if we hold our place in the line, but also fill vacancies which occur in the course of business, and to provide for this demand, we must give some thought to the preparation of salesmen.

Having decided that we must resort to the training of our own men, not depending upon our competitors for our supply, therefore a salesman's training course should be provided, that the increasing demand will be taken care of.

Young men who, we believe, possess inherent ability to ultimately succeed in commercial sales work should be given a systematic training, schooled in the fundamental principles of salesmanship; encouraged in the study of electricity and made familiar with the policies of the company, the product you handle and thorough sales demonstrations and personal quizzes at regular intervals. Question them on subjects they should know. Propound questions that you are reasonably sure they cannot answer in order to see how they will handle themselves when they are in a similar predicament with customers.

The study of catalogues and price books, forms of contracts, sales reports, stocks carried, house forms, etc., are essential to the training of salesmen and unless a company is making such provisions, just so sure will they fall behind in the race for business.

In these days of modern and scientific business methods an efficient sales force cannot be created in a day, neither can it be purchased for a money consideration. It may be brought to a state of perfection only by a process of evolution, calling for careful judgment and wise discrimination in selecting the material to be used.

There must be on the part of both management and selling force, implicit confidence in each other, loyalty to each other's interest at all times and under all conditions.

A selling force thoroughly trained and woven together with due consideration to all the points mentioned when properly directed, can not help but get their share of the business at a satisfactory profit.

GAS ENGINE GASTRITIS.

BY H. N. SESSIONS.[1]

Los Angeles, California, April 15, 1912.

Rhyolite Hydro-Electric Company,
Garden Villa, Orange Co., Cal.
W. L. Dumpling, Manager.

Dear Sir:

Alas! I am compelled by terror to confess my error in trying to use gas engine for power. Six months' experience with this breech-loading fire-arm engine has been one nerve-racking nightmare. For a twenty-two horse it barked like a 44 Colt's; nay, its neighs were even louder. The company which reduced me to buy it is still in the "hands of a deceiver" and will not take it back, so for its disposal I am driven from the bunkman to the junkman. Oh! the misplaced confidence I put in that engine. After constant courting and the loss of one finger the ungrateful thing will not even turn over and reciprocate a stroke. Instead of a trusty one I find only a rusty ton. I have renewed every part of it except the name plate; but never again, not another part of it, til I part with it. I fed the engine on gasoline, naphthaline, benzine, lucine and kerosene. I greased it with glycerine, paraffine, cottolene and oleomargarine. It vacillated on vasoline and finally became a tippler on Tops, turning topsy-turvy and died on the diet. Now it rests serene a sight obscene in its oily refinery.

Come quick with your poles and wire. I have seen Smith's sturdy motor softly singing with your steady service while the air surrounding still smells sweet, so spare no speed, but serve the juice. I want appliances, too, with heat that's hot, also lamps that light, and a fan when it's warm to blow up a storm, and, damn it, last, but not least, I must have power with peace not grease.

Yours for relief,

AL. FALFA.

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[1]Commercial Engineer Southern California Edison Company, Los Angeles, Cal.

JOURNAL OF ELECTRICITY
POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The California Water Commission

A bill establishing a Water Commission in California but awaits the signature of the Governor to become effective, or rather defective, in regulating future acquisition of water in that State. In its amended form, it represents a great improvement over the original bill proposed by the Conservation Commission, but it is still woefully ambiguous and lays the foundation for much litigation. While the motives of its framers are apparently of the best, we cannot but think that it is better to be delivered into the hands of evil-intentioned rascals than well-meaning fools. As an instrument to forge new fetters and retard the future development of water power resources it certainly is admirable.

The act creates a Commission of five; the Governor and the State Engineer by the virtue of their office, and three properly qualified members appointed by the Governor for a term of four years, at an annual salary of $5000 each. It shall be their duty to ascertain whether the water now in use has been appropriated under the present laws of the State, or if it has been put to the uses for which it was appropriated. If not, it is to be declared unappropriated, as is also any water that shall not have been applied to useful purpose within ten years hereafter. Such an investigation represents an unnecessary expenditure of State money for which the State has nothing to gain, as such action is one of the first duties of a new appropriator of lapsed claims.

The Commission is also given power to prescribe the time within which the full amount of water appropriated shall be applied to a useful purpose. If the full capacitiy is not developed within a period deemed reasonable by the Commission, any other applicant may be granted joint occupancy. The danger in this section resides in the possible abuse of the arbitrary powers of discretion given the Commission. A saving clause, however, requires such applicant to pay a due proportion of the cost of the original diversion works. Appeal from the decisions of the Commission may also be made to the courts.

The necessary procedure in applying for a permit to use unappropriated water is fully detailed. Such preliminary permit is revocable if construction is not started and completed within the time specified. When the work is completed to the satisfaction of the Commission, they may then issue a license which shall be effective as long as the water is used for the purpose for which it was appropriated. While this indeterminate license for power purposes is in accord with the recommendation of a committee from the Commonwealth Club of California, it does not offer sufficient protection to the investment to make the proposition attractive to the average investor. It is further subject to the condition that the property may be taken over after twenty years by any city or any political subdivision of the State. With reference to irri-

gation purposes, little or no excuse can be advanced for its inclusion in the bill.

Capitalization of a water right is definitely prohibited in the clause, "No value whatsoever in excess of the actual amount paid to the State therefor shall at any time be assigned to or claimed from any permit or license granted under the provisions of this act." While somewhat revolutionary in character, this provision is in accord with the most advanced ideas of public regulation of public utilities.

Before a permit or license can be issued, a fee must be paid, the amount depending upon the purpose to which the water is to be applied. If for the generation of electricity, the requirement is an initial payment of $2.50, "for each theoretical horsepower capable of being developed by the works up to 100 horsepower," the minimum fee being $25.00. For developments between 100 and 10,000 horsepower, the fee is $500.00, and when above 10,000 horsepower, $1000. When the license is issued, and annually thereafter, a charge of 25 cents per horsepower is to be made, except in private developments not exceeding 50 horsepower. For other than power purposes, the initial fee is $10.00, with an annual charge of 10 cents for each miner's inch. This annual charge is a bad feature of the bill, particularly in view of the fact that the State offers no return therefor. It is not countenanced by better legislation elsewhere, and is repugnant to public policy in the development of our water resources. Like all taxes, it must eventually be borne by the ultimate consumer.

Theoretically and individually, many of these requirements may be good; practically and collectively they will greatly hamper future development of water power by private initiative and capital. The financing of a water power project was difficult even before these new restrictions were exacted. With their enforcement, capital will be forced to seek new fields. Water is different from the other great natural resources, such as oil, coal or metal, in that its development enriches the country; mines in a sense may be said to impoverish a country, especially when developed by foreign capital. One is a benificent utilization, the other a selfish exploitation. Wisdom would therefore seem to dictate that every means be lent to encourage the use of water, and not to add to the discouragements contained in the provisions of this new law. Grave accusations are made of the manner in which this vicious piece of legislation was passed and there is strong probability that even if it be signed by the Governor it will be declared unconstitutional by the courts.

Responsibility for Strike Damage

Electricity has created a new world. So accustomed have we become to an electrical civilization, that it is only when the threat is made to stop its supply that one realizes the economic, social and moral influences which have emanated from it. The telegraph, telephone, electric light, motor and heating appliances have successively been perfected within the memory of many a man now living. The experiences of youth, united with the work of manhood and the reflections of old age, constitute the history and philosophy of electricity as we know it to-day.

Electricity spans distance, lifts weight and saves time, the three physical obstacles to progress which are so fundamental as to be adopted as the basis of all physical measurement. National and international unions, scientific, literary and industrial, have sprung up in quick response to the throbbing of the enlarged life it gives. Undeniably, it is the greatest agent of universal progress the world has ever known.

So intimately has electricity become interlocked in the chain of the every-day life of the every-day person that a concerted effort should be made to frustrate any such possibility to the interruption in service which has been threatened by the recent strike among the employees of the Pacific Gas and Electric Company. Happily, the company has been able to maintain a most praise-worthy service, and as this is written, a great majority of the strikers have returned to work and the artificial Light and Power Council is suffering from defection of members. The remaining problem is to prevent the recurrence of such trouble. There has been much praise in little fault found in our previous suggestion that matters of this kind be referred to arbitration by the Public Service Commission.

Law-makers have harnessed the public service corporations as the engineer has harnessed the forces of nature. But this law harness has not proved as efficient as the engineering harness. The collar has been unevenly padded, so that parts of the shoulder have become sore, while other parts have escaped the pressure of the draft. Important buckles have been omitted and all straps have not been sewed together. The horse has been compelled to conform to the harness, rather than the harness to the horse. It seems high time that some tribunal be established which will be mutually acceptable to the public utility company and to its employees. When the law regulates rates it should also protect investment.

During the past month there have been a number of strikes in different parts of the country. These have unnecessarily occasioned loss and suffering not only to the employees and the companies, but also to the public. The duties of the Public Service Commission include both regulation and protection. Under the latter heading, the United States District Court at Newark, N. J., has given a verdict against a municipality for losses caused by failure to provide protection against strike damage in the case of an express company, which comes under the head of public service. A damage to both property and to business resulted from inadequate police protection. If this verdict is sustained it will prove our contention that a public service corporation is entitled to the benefits and privileges of commission protection as well as subject to the burdens and responsibilities of commission regulation.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

R. Q. B. Cleavenger of the Phoenix Glass Company, Pittsburgh, was in Seattle recently.

E. L. Callahan of the Faries Manufacturing Company Decatur, Illinois, was in Seattle some days ago.

Stuart Hines has become associated with the sales force of the Pacific States Electric Company of San Francisco.

H. A. Sayles of Holobird-Reynolds of San Francisco, has been spending a few days in Sacramento in the interests of business.

Morton Allen, general telephone and sales manager of the Northern Electric & Manufacturing Company of Montreal, was in Seattle recently.

E. Cutting has been appointed superintendent of the municipal electric lighting plant at Riverside, Cal., succeeding F. A. Worthley, resigned.

H. Bewlay, chief engineer of the Ideal Electric & Manufacturing Company of Mansfield, Ohio, is visiting their Pacific Coast office in San Francisco.

H. C. Reed, superintendent of the Pacific Fire Extinguisher Company, has returned, after a month's stay in Portland attending to business interests there.

H. Harris, formerly associated with the General Electric Company at Schenectady, and later located in London, has become identified with the sales force of the Pacific States Electric Company.

Raymond J. Andrus, vice-president and general manager of the Northwest Electric & Water Works of Seattle, is in San Francisco in connection with the proposed gas works at Bremerton, Washington, which he is promoting.

J. C. Rendler and **W. S. Hanbridge** have been re-elected as directors to the National Electrical Contractors' Association to represent the California State Association of Electrical Conractors at Chattanooga, July 17, 18 and 19, 1913.

Geo. A. Boring, connected with the Pacific States Portland branch since its opening, has been appointed to the position of district sales manager of that house, and **E. A. Norton** appointed to a similar position, covering Seattle territory.

E. J. Barry, electrical engineer of the St. Paul & Tacoma Lumber Company, Tacoma, has returned from his trip to Elk River, Idaho, where he made tests on the electric logging donkeys now in operation on the Potlatch Lumber Company's holdings.

R. B. Elder expects to leave San Francisco during the coming week on an extended Eastern trip, visiting his several principals, among them the Ideal Electric & Manufacturing Company at Mansfield, Ohio, and the Moloney Electric Company at St. Louis.

W. W. S. Butler has resigned as general manager of the Western States Gas & Electric Company at Stockton, Cal., after most efficient service in firmly establishing the Byllesby interests in the town. **Sam Kahn** has succeeded to his duties. Mr. Butler is now in the East.

W. E. Herring, who recently became connected with Puget Sound Traction, Light and Power Company as industrial agent, has established headquarters in the Pioneer Building. He will devote his time to procuring new industrial enterprises for the Sound country.

Harry Tittle has taken over the electrical department of the John G. Sutton Company, and same will be conducted under the former's name. Mr. Tittle has been connected with the electrical contracting business for many years, and has had charge of some of the largest electrical installations in this vicinity.

M. E. Crawford of the Seattle Section, A. I. E. E., was elected as a delegate to attend the annual convention to be held at Cooperstown, New York, June 23d to 27th. He will leave about June 1st and visit a number of the Stone & Webster plants in the east before he goes to the convention.

Allen E. Ransom for some years connected with the Seattle office of the Westinghouse Electric & Manufacturing Company in the industrial and power department and later assistant general manager of the Olympic Power Company at Port Angeles, Washington, is now manager for the Caldwell Machinery Company, Seattle.

Kunihiko Iwadare, managing director of the Nippon Electric Company, Ltd., of Tokyo, which firm is representing the Western Electric Company in Japan, and **I. Miyaji,** of the same concern, were recent visitors in San Francisco, en route to Chicago and New York, where they expect to spend considerable time visiting the Eastern electrical concerns.

W. A. Blair, president of the Electrical Credit Men's Association, has called the regular annual meeting and banquet of the association for June 3rd. Among the invited guests will be **W. W. Briggs** of the Great Western Power Company; **H. V. Carter,** Pacific States Electric Company; **F. Skeel,** Crouse-Hinds Company, and **F. H. Leggett** of the Western Electric Company.

At the annual meeting of the American Institute of Electrical Engineers held May 20th, **C. O. Mailloux** of New York was declared elected president. **H. H. Barnes,** New York, **J. A. Lighthipe,** Los Angeles, Cal., and **Charles E. Scribner,** New York, were declared elected vice-presidents; **B. A. Behrend,** Boston, Mass., **Peter Junkerfield,** Chicago, Ill., **H. A. Lardner,** San Francisco, Cal., and **Lewis T. Robinson,** managers; and **George A. Hamilton,** treasurer.

Franklin F. Griffith, the incoming executive of the Portland Railway, Light & Power Company, made his initial appearance before 2000 employes of the company at the Oaks Theater last week, and at the same time **B. S. Josselyn,** the retiring president, made his farewell address in which he urged that the same loyal co-operation and fellowship be shown to Mr. Griffith that had been extended by the carmen to himself during his six years at the head of the company.

Golden Poppy Special Party left Thursday morning, making up one of the jolliest, liveliest bunch of Western boosters which has invaded the East for some time. The party was made up as follows: Mrs. Walter H. Seaver and three children, San Francisco; Fred H. Poss, Benjamin Electric & Manufacturing Company, San Francisco; Miles F. Steel, Benjamin Electric & Manufacturing Company, San Francisco; Carl E. Heise, Westinghouse Electric & Manufacturing Company, San Francisco; Mrs. Carl E. Heise, San Francisco; J. W. Wiley, West Sacramento Electric Company, Sacramento; Mrs. J. W. Wiley, Sacramento; Chas. F. Conn, J. G. White & Co., San Francisco; Arthur H. Halloran, Journal of Electricity, Power and Gas, San Francisco; A. J. Myers, Wagner Electric Company; Harry Hays, Mt. Whitney Power Company, Visalia; Mrs. Harry Hays, Visalia; T. E. Bibbins, General Electric Company, San Francisco; Mrs. T. E. Bibbins, San Francisco; H. B. Squires, H. B. Squires & Co., San Francisco; C. E. Mynard, Great Western Power Company, San Francisco; E. A. Quinn, Allis-Chalmers Company, San Francisco; Thos. E. Collins, Westinghouse Electric & Manufacfuring Company, San Francisco; A. Garnett Young, Telephone Electric Equipment Company, San Francisco; Mrs. A. Garnett Young, San Francisco; H. T. Matthew, Electrical World, San Francisco; M. V. Van Fleet, San Francisco; George A. Campbell, Truckee River General Electric Company, Reno, Nev.; Mrs. Geo. A. Campbell, Reno, Nev.; Mrs. C. H. Harwood, New York, N. Y.; John Coffee Hays, Mt. Whitney Power Company, Visalia; Mrs. John Coffee Hays, Visalia; Fred G. Hamilton, Mt. Whitney Power Company, Visalia; Mrs. Fred

G. Hamilton, Visalia; O. D. Pierce; S. M. Kennedy, Southern California Edison Company, Los Angeles; A. E. Murphy, Southern California Edison Company, Los Angeles; W. S. Sessions, Southern California Edison Company, Los Angeles; H. M. Hall, General Electric Company, Los Angeles; J. R. Glynn, Salt Lake, Utah; K. E. Van Kuran, Westinghouse Electric & Manufacturing Company, Los Angeles; Mrs. K. E. Van Kuran, Los Angeles; A. E. Drake, Woodill, Hulse & Co., Los Angeles; Mrs. A. E. Drake, Los Angeles; Wm. Baurhyte, Los Angeles Gas & Electric Company, Los Angeles; Miss Constance Metcalf, San Francisco.

MEETING NOTICES.

Oregon Technical Club.

The regular luncheon of the Oregon Technical Club was held at the Portland Commercial Club, Monday, May 19th, the speaker of the day being Mr. D. L. Williams, architect. Andrew Fouilhan presided over the meeting. The regular chairman and speaker, as announced previously, were unable to be present on account of business outside of the city.

Electrical League of Southern California.

The Electrical League of Southern California held its regular meeting at the Angelus Hotel, Tuesday, May 27, 1913. Mr. O. H. Ensign, Chief Electrical Engineer of the United States Reclamation Service, gave a talk on "Power Development of the Reclamation Service," which was thoroughly enjoyed by all present.

Los Angeles Section, A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers held its regular monthly meeting at Hotel Hollenbeck, on Tuesday evening, May 27th. Prof. R. W. Sorensen of Throop Polytechnic Institute, Pasadena, presented a paper on "Some Values of Wave Form Analysis." The paper was followed by an interesting discussion of the facts presented.

Electrical Development and Jovian League.

Tuesday's meeting was Jobbers' Day, and the meeting was conducted by H. V. Carter of the Pacific States Electric Company. The speakers of the day were F. Skul of Crouse-Hinds Company, who is on the Pacific Coast at present, and F. H. Leggett of the Western Electric Company, who told some very interesting happenings of the days when he toured Europe and the Orient.

Portland Electrical Contractors' Association.

The regular monthly meeting of the Portland Electrical Contractors' Association took place at the Portland Commercial Club at 6:30 p. m., May 14th. The following officers were elected: President, W. O. Fouch; vice-president, Robert Skeen; secretary, F. C. Green; treasurer, J. R. Tomlinson; Knight; membership committee, Messrs. Drouillat, Littler, Knight; membership committee, Messrs. Drouillat, Littler, Walker and Potter. The committee to have charge of the next semi-annual state meeting, which is to be held Monday evening, June 9th, the week of the Rose Festival, is as follows: Messrs. Tomlinson, Pierce, Smith and Littler.

Seattle Jovian League.

The Seattle Jovians were addressed at their luncheon given on May 23d by Roland W. Cotterill, secretary to the city park board. The address covered the parks, boulevards and playgrounds of the city. The talk was illustrated showing the successive steps that have been employed in bringing them to their high state of perfection. Particular stress was laid on the playground phase of the subject, the speaker claiming that statistics would show Seattle further advanced in this respect than any other city in the country except Chicago. The resignation of C. M. Bliven, chairman of the league, was received and laid on the table for action at a future meeting. The committee selected to report on a plan for participation by the Jovians in the coming Potlatch made its report and same will be the order of business for the next regular session. The plan outlined by the chairman of the committee gives promise of being satisfactory.

Portland Section, A. I. E. E.

The last monthly meeting of the Portland Section of the American Institute of Electrical Engineers was held in the old grill of the Oregon Hotel at 7 p. m., May 20th, where 50 members and their friends sat down to an elaborate banquet.

During the luncheon they were entertained by Messrs. E. I. Whitney and E. A. West, with many short poems, squibs, and stories, applicable to the business of electrical engineering and to the various members present.

Mr. I. E. Staples, accompanied by Mrs. Staples, rendered several vocal solos. Several piano solos, rendered with credit by Mr. J. Paddock. Dophne Lewis and Marion Rollins, with their vocal solos, completely dispelled the cares of the most sedate, and Mr. S. I. Weill ilustrated what an engineer could accomplish in the mastery of music, through the medium of a mandolin.

Talks were given by the following gentlemen: Messrs. H. R. Wakeman, G. P. Nock, O. B. Coldwell, W. A. Hillebrand, H. M. Friendly and W. D. Scott. After the banquet the officers for the ensuing institute year were elected as follows: G. P. Nock, chairman; R. F. Manges, secretary; C. E. Condit, W. D. Scott, H. R. Wakeman; executive committee; H. M. Friendly, delegate to the national convention at Cooperstown, N. Y.

Everyone present was unanimous in the opinion that this banquet was one of the most enjoyable affairs ever held by the local section of the Institute.

Oregon Society of Engineers.

On May 17th, the Oregon Society of Engineers conducted an excursion party to the State University at Eugene. Three hundred representative men and women from all parts of the state gathered together for this trip and participated in the Fifth Annual Commonwealth Conference. At this time a movement is on foot to referend the legislative appropriations for the maintenance of the university and the excursion was calculated to serve as a remonstrance against such movement.

The party traveled via the Oregon Electric, leaving Portland by special train at 7:30 a. m., and at 11 a. m. reached Eugene, where autos were in waiting. The famous "Radiators" of Eugene, five thousand strong and known in and out the state for their "Eugene way" of doing things, conducted the entire party about the city for a short drive, then out to the university. President P. L. Campbell of the university, and Mayor D. E. Yoran of Eugene delivered addresses of welcome and responses were given by President W. H. Graves of the Oregon Society of Engineers and President James Kerr of the Oregon Agricultural College. A splendid luncheon was served in the gymnasium by the girls of the College of Domestic Science. The class in dramatic art then gave Peer Gynt and scenes from Midsummer Night's Dream, interspersed with folk dances.

At the session for engineers a paper was presented by Mr. Fred F. Henshaw, District Engineer, U. S. Geological Survey, entitled, "State and National Co-operation in the Development of Oregon's Water Resources." State Engineer John H. Lewis and Mr. W. K. Newell of the State Horticultural Society, led the discussion of the paper.

Mrs. Campbell, Mrs. Friendly and Mrs. Dixon, wives of the president and regents of the university, held a reception for the women of the party and entertained them at luncheon in the Japanese tea room of the Hotel Osburn. The men were entertained by the Eugene Commercial Club under the splendid supervision of Mr. Morris J. Duryea, Manager Publicity Department. At 8 p. m. the Engineers' special swung out onto the main line bound for home, bearing 300 persons who had never known a happier day.

INDUSTRIAL

THE E. S. B. AXLE LIGHTING SYSTEM.

The axle lighting system which has been in process of development by The Electric Storage Battery Company for a number of years has recently undergone a most successful test on the system of the Atchison, Topeka & Santa Fe Railway, as a result of which the Santa Fe has placed an order for sixty-two of these equipments. This system combines simplicity, reliability, minimum attention and maximum battery life. It is a constant voltage rather than a constant current system. The accompanying diagram, Fig. 1, illustrates the mode of operation.

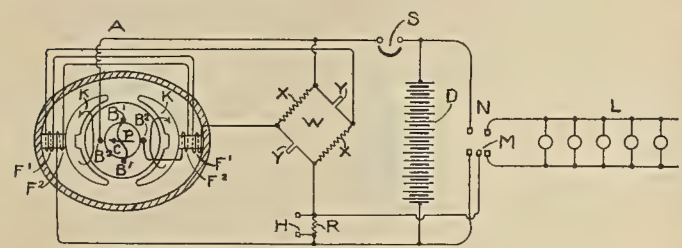


Fig. 1.

The dynamo A is of the Rosenberg type used abroad very extensively for a number of years in axle lighting, but redesigned by The Electric Storage Battery Company to operate in connection with its constant voltage regulator. Current in the primary field winding F^1 produces a small primary field flux represented by the arrow P, which induces a small electromotive force between the short-circuited brushes B^1 and a flow of current through the short-circuit connection C. This current, flowing through the armature winding, produces by armature reaction the secondary or principal field flux, which does not pass through the frame of the machine, but is confined to the heavy pole shoes and the armature as shown by the arrows K. This latter flux produces the electromotive force at the principal brushes B^2, which are connected to the external circuit, a series field winding F^2 in this circuit serving to balance the armature reaction due to load. An important advantage of this type of machine lies in the fact that it generates the same polarity with either direction of rotation, thus requiring no pole changer.

The primary field winding F^1 is connected across opposite junction points of the Wheatstone bridge W, the other two junction points being connected respectively to the positive and negative terminals of the machine. This bridge is designed to give the constant voltage characteristics above mentioned. It includes fixed resistances X in opposite branches and iron wire ballasts Y in the other two branches.

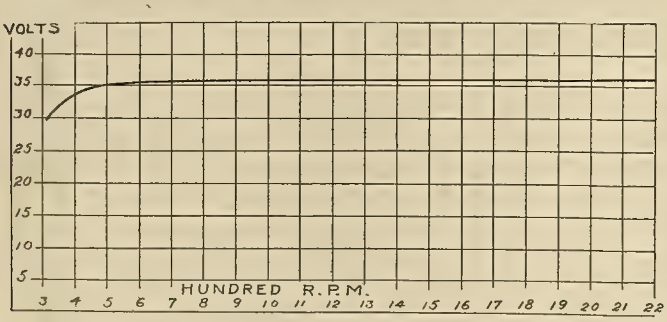


Fig. 2.

The latter, on account of their high temperature coefficient, have a practically constant current characteristic under operating conditions. This combination of circuits produces a field excitation continually diminishing with increase of speed. The resulting speed voltage characteristic of the dynamo is shown in Fig. 2.

An automatic switch S connects the dynamo to the battery D when the voltage of the former is slightly above that of the latter and opens when the output of the dynamo drops to zero. The knife switch N connects the lamp circuit L to the battery.

The voltage of the dynamo is fixed at a point slightly above the floating voltage of the cells, thus insuring that the battery is always fully charged. The difference between this voltage and that of the battery on discharge is, however, so small and the change from one to the other so gradual that no lamp regulator is required.

Should it ever be found necessary to give the battery a high voltage charge, this may be done during a daylight run by means of the fixed resistance R, normally short-circuited by the switch H and also by the clip M on the main lamp switch. When both of these switches are open, the voltage of the dynamo is raised by an amount determined by the value of the resistance R. Whenever lights are required, the closing of the lamp switch N short-circuits the resistance R, reducing the voltage to normal and eliminating the possibility of excessive voltage at the lamps. During five months of continuous operation of a demonstration equipment, no occasion for such a high voltage charge has arisen.

This system automatically adjusts the output of the dynamo to the requirements of the service, and gives the battery the slight amount of overcharge required to keep it practically full and in good condition, but no more, producing conditions of operation ideal for maximum battery life. Should the battery become discharged by a prolonged stop with lamp load on, its charge will be rapidly restored during the subsequent run. Should the car be transferred from a daylight run to one requiring considerable artificial lighting, the output of the dynamo will increase to meet the changed conditions of service. This is all accomplished automatically without manual adjustment of any kind.

NEW CATALOGUES.

The Improved Equipment Company, combustion engineers at 60 Wall steet, New York City, have published an instructive catalogue on Silica Retorts and Settings for Gas Benches.

Bulletin No. 152 from the Crocker-Wheeler Company is an interesting exposition of steam turbine driven generators for alternating current ranging in capacity from 50 to 6000 kw. and for direct current for from 1 to 300 kw. at speeds of from 4000 to 1400 r.p.m.

The Chicago Pneumatic Tool Company of Chicago, Ill., has just issued a bulletin covering their complete compressor line, and treating of general information of value to users of compressed air. The bulletin contains information for intending purchasers showing the data required for intelligent estimates.

The General Electric Company has recently issued the following bulletins: No. A4071 illustrates and describes Ornamental Lamp Brackets and Center Span Suspension Fixtures for Series and Multiple Incandescent Street Lighting. No. A4095 is devoted to d.c. Switchboards with Equalizer Switches on the panels, double polarity, 125 and 250 volts. No. A4087 gives information on d.c. Motor Starting Panels for heavy service. Electric Arc Headlights is the subject of No. A4061, which contains much material of interest and value. No. 4974A gives a graphic comparison of the advantages of Edison Mazda Lamps for Standard Electric Railway Service.

REMOVAL NOTICES.

The Kendrick Electric Company has closed its store at 714 Commerce street, Tacoma, and moved the stock to Seattle.

Ford, Bacon & Davis, the Sierra & San Francisco Power Company, the Coast Valleys Gas & Electric Company, and the Monterey & Pacific Grove Railway Company, announce the removal of their general offices to 58 Sutter street, San Francisco, Cal.

NEWS OF THE ELECTRICAL CONTRACTORS.

The electrical contract for wiring the new Northwestern Bank Building, on Morrison street, between Sixth and Seventh streets, Portland, Oregon, has been awarded to the Pacific Fire Extinguisher Company. This company has also obtained the electrical contract for the Trimble Estate building on the northeast corner of Park and Oak streets.

The electrical contract for the new theater, located at Fourth and Burnside streets, Portland, Oregon, has been awarded to the Caffery, Reardon Company of Portland.

Ne Page, McKenny & Company, of Seattle, Wash., have been awarded the electrical contract for the Davenport Hotel at Spokane, Wash.

C. H. E. Williams, Henry building, Seattle, has the contract for electrical installations in the new Colonial theater building being erected on Fourteenth and Pike streets.

NEWS OF WASHINGTON PUBLIC SERVICE COMMISSION.

The Washington public service commission has ordered a reduction of gas rates in the city of Spokane. The commission found that a fair valuation of the plant of the Spokane Gas & Light Company and the Spokane Gas & Fuel Company, operated as one company or corporation is $1,100,000. The present schedule of rates is as follows: Net rates, $1.50 per 1000 cu. ft. (flat rate); gross rates, $1.75; discount 25 cents; minimum charge, 25 cents per month. The new schedule is as follows: Net rates: First 2000 cu. ft., $1.40 per 1000; next 3000 cu. ft., $1.30 per 1000; next 5000 cu. ft., $1.20 per 1000; next 5000 cu. ft., $1.10 per 1000; all over 15,000 cu. ft. $1 per 1000; gross rates: 10 cents per 1000 cu. ft. higher than net rates; discounts, 10 cents per 1000 cu. ft. The new schedule will be put into effect July 1, 1913.

The Washington public service commission has formally adopted the danger sign for railroads provided for in the trespass act passed by the recent legislature and the red card tag for electrical switches called for in the electrical code passed by the same legislature. Both forms are being sent to the various railroads and electrical establishments in the state. All lines affected must put up before June 12th the following sign: "Danger! Trespassing on this property is a misdemeanor, punishable by fine and imprisonment. Chapter 128, laws 1913." The electrical code provides that every switch opened for the purpose of allowing linemen or others to work on the system must be supplied with a red card to be filled out as to time of opening, by whom it was opened and purpose of opening, to be signed by the person opening same. The idea is to do away with danger to workmen through carless switch operators.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Pacific Gas & Electric Company has applied to the railroad commission for a certificate of public convenience and necessity for the construction of three additional power plants on the extension of Bear River, Placer county, and the construction of a transmission line from the Bear River development to Nicolaus in the Sacramento Valley. The applicant stated that the construction would provide for 35,000 horsepower at a cost of $2,396,000.

A decision was rendered granting authority to the Maclay Rancho Water Company to sell its telephone system, water and power systems in and around San Fernando, to the Consolidated Securities Company.

A decision was rendered granting authority to the Pacific Gas & Electric Company to issue $5,000,000 of debentures for the following purposes. Reimbursement of treasury for money expended upon capital construction from income, $3,750,000; for new construction work over the company's system, $1,250,000.

The Oro Electric Company has filed a petition asking for a rehearing upon the matters involved in its application for a certificate of public convenience to distribute electricity in Stockton.

The Mount Jackson Water & Power Company has applied for authority to increase water rates to its consumers at Rio Nido, Sonoma county.

A decision was rendered granting authority to the Half Moon Bay Light & Power Company to reimburse its treasury to the amount of $1165 through the sale of stock.

A supplemental order was issued granting authority to the Tulare County Power Company to issue $15,971 of promissory notes, and to pledge its bonds as collateral security therefor.

The Southern Sierras Power Company has applied for a certificate of public convenience and necessity to proceed to the completion of its work in Riverside county.

TRADE NOTES.

Evans-Dickson Company, Tacoma, recently sold to L. J. Vogtor a 50 h.p. motor for his gravel pit near the city.

The Arrow Electric Company 1627 Fourth avenue, Seattle, has just completed the wiring on the Montesano, Washington, High School.

The Sound Electric Company, 1010 First avenue, Seattle, has put in 2-50 h,p. motors for the P. G. McHugh asphalt paving plant on Lake Union.

The McGoldrick Lumber Company will install a 50 kw. direct current Allis-Chalmers generator for supplying power and light at its Spokane plant.

Preparations have been made by the Tacoma municipal lighting department for cooking demonstrations to be given during the first two weeks of each month at the city hall.

The A. G. Electric & Manufacturing Company, Seattle, has redesigned its 30-ampere knife switch, bringing it up to the new Underwriters' standard, which goes into effect October next.

David Dow & Son, Twenty-first and Spruce streets, Seattle, have purchased all of the electrical equipment, locomotives, etc., of the Whatcom Coal Company at Bellingham, Washington.

The Pacific Coast Coal Company will install an Allis-Chalmers Corliss engine 26 x 36 inches direct connected to a 300 kw., 120 r.p.m., 575 volt railway generator together with switchboard at its coal mines, Renton, Washington.

The entire sales department of the Puget Sound Traction Light & Power Company visited the Snoqualmie Falls power plant of the company some days ago, the object being to have the force familiarize itself with the equipment.

Cummings & Kiehl engineers, 506 Central building, Seattle, have begun the work of replacing a mile of wood stave pipe with 4 to 7 foot steel pipe for the Vancouver, (B. C.) Power Company, in connection with its Lake Buntzen power plant.

The city of Seattle has very recently placed in operation a complete stone crushing plant in connection with construction of the Cedar River dam. The plant is operated by a number of Allis-Chalmers induction motors of the cement mill type.

The Olympic Power Company, Port Angeles, Washington, has placed a contract for the substructure of its dam which blew out last fall, with James O. Hayworth, a Chicago con-

tractor. Mead & Seastone of Madison, Wisconsin, are the engineers on the job.

The St. Maries Lumber Company of St. Maries, Idaho, has installed a 500 kw. low-pressure Allis-Chalmers steam turbine unit for driving motors in its planing mill. This turbine will be equipped with an Allis-Chalmers type C centrifugal jet condenser.

The Seattle Construction & Drydock Company will drive a large air compressor with a 200 h.p. slow speed Allis-Chalmers motor of the heavy duty type recently purchased. The power will be supplied by the Puget Sound Traction, Light & Power Company.

The city of Ellensburg, Washington, will install a 300 kw. Allis-Chalmers generator in its new municipal lighting plant. This will be direct connected to a Francis turbine. The city has also ordered from the same company a motor generator set and 3-panel switchboard.

The Caldwell Machinery Company, 524 First avenue South, South Seattle, recently installed a small direct-connected unit for the Burbank Company at Burbank, Washington. The company also recently put in a light and power plant for the Mrs. Sanders ranch at Ellensburg, Washington.

Nicholas Lawson, commissioner of light and water Tacoma, has let a contract to N. A. Jones. local contractor, for the installation of 1660 ft. of 12 in. wood stave pipe and 7350 ft. of 6 in. wood stave pipe in the vicinity of Bismark, a suburb of the city. The contract price approximates $8000.

The Campbell River Lumber Company, White Rock, B. C., has placed orders with the Allis-Chalmers Company for a complete sawmill. This will be electrically driven throughout with about 1000 h.p. in electric motors of various sizes. The power will be furnished by the British Columbia Electric Company.

Buxbaum & Cooley, electrical engineers and contractors, 68 Columbia street, Seattle, recently installed a new enunciator in the steamer Iroquois. The company recently sold to the Manganese Products Corporation a 10 kw., 50-volt direct current hydroelectric plant to be used for lighting a large hotel in the Olympic mountains.

W. B. Collins, superintendent of electric works, Tacoma, announces that the city is preparing for heating and cooking demonstrations in connection with the general house furnishing store of Davis, Smith & Company in that city. The owners of the store will furnish the various makes of stoves, the space desired and do the advertising while the city will do the demonstrating.

Owing to a heavy increase in business the Manley-Moore Lumber Company of Tacoma has decided to double the capacity of its power plant and has placed an order with Allis-Chalmers Company for one 175 kw. form a.b. alternating current generator together with exciter and switchboard. A number of motors have been procured from the same source for use in various departments.

K. C. Schluss, superintendent of power and equipment Tacoma Railway & Power Company announces that 10 new car equipments have been received for the city lines. The cars are double end, 47 feet and 5 inches over all, semi-steel, without bulkheads, folding doors, pay on entry and a seating capacity of 52. They are equipped with 4 General Electric, 219 B. motors, K 35 controller, standard 0 50 tucks. Have National Break & Electric Company equipments with A 5 compressors; have both incandescent and arc headlights, air sanders and drop fenders.

Lewis, Wiley & Morse, Inc., hydraulic contractors, 706 Central building, Seattle, have the contract for filling Alki avenue from Atlantic street to Spokane avenue, a distance of 1¼ miles. One of the three units used by Lewis & Wiley on the Jackson street regrade is being used, consisting of a Westinghouse motor and two 4-stage centrifugal Worthington pumps. Seven hundred h.p. is utilized pumping 6,000,000 gallons per day against a 375 foot head. The dirt being used on the fill is being taken from the site of the proposed city stadium in West Seattle. Lewis, Wiley & Morse have become associated with the Ambursen Hydroelectric Company and will build the earth filled dams for that company.

BOOK REVIEWS.

Foundations and Machinery Fixing. By Francis H. Davies, A. M. I. E. E. Size 4¼ x 6½ in.; 152 pages; 52 illustrations; cloth binding. Published by D. Van Nostrand Company of New York, and for sale by The Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $1.00.

The writer of this book who is also author of "Electric Power and Traction," and "The Commercial Engineer's Pocket Book," has contributed this as one of the several installation manuals recently published by this house. The subject of engine and machine foundations is a strangely neglected one. In this little work such subheadings as functions of foundations, trial bores, materials for foundations, holding-down bolts and anchor plates, excavation, construction, causes and effects of vibration and methods of isolating machinery are consecutively treated. The book is simple, yet thorough in its treatment, its only possible drawback for Western engineers being that the English monetary system is used throughout.

Regulation, Valuation and Depreciation of Public Utilities. By Samuel S. Wyer, Consulting Engineer. Size, 5½ x 8½ in.; 313 pages; replete with diagrams and tables; leather binding; gilded edges. Published by the Sears & Simpson Company of Columbus, Ohio, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $5.00.

This book, which is written by a consulting engineer of full standing in the leading national engineering societies, treats in sixteen separate chapters of the public and the public utility in their respective relationship as to regulation, valuation and depreciation. Fundamental definitions, economies of utility problems, governmental power to regulate utilities, principles governing cost of utility service and engineering data necessary, constitute the leading subjects of discussion. Thirty-five pages are devoted to an excellent author's and subject index. A selected bibliography is also appended, which will be found useful. The chapters on electrolysis as related to depreciation contain much useful matter. The book will add much to the rather limited number of reference books upon this subject now available.

A Symposium on Scientific Management and Efficiency in College Administration. Comprising among others the papers presented at the efficiency session of the twentieth annual convention of the Society for the Promotion of Engineering Education. Size: 5½ x 8½ in.; 226 pages; one illustration; cloth binding. Published by the Society for the Promotion of Engineering Education and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $1.00.

The book opens up with an introduction by F. B. Gilbreth showing by chart what scientific management is and what it can do. The various chapters are written by such well known men as F. A. Parkhurst, W. F. M. Goss and Wm. Kent. The papers all refer to the general subject of efficiency either as applied to college administration or to the conduct of business. In the latter case the papers deal with fundamental principles or with the actual teaching of scientific management. The range of discussion covers such subjects as educational demands of modern progress, the engineer as a manager and a broadened view of efficiency in engineering instruction. The book is most interesting throughout and unquestionably fills a place hitherto vacant in educational thought. The appendix written by F. B. Gilbreth on the place of motion study in scientific management fittingly closes this unique symposium.

NEWS NOTES

ILLUMINATION.

FRESNO, CAL.—Mayor Snow has under consideration a plan for the establishment of a municipal lighting plant in Fresno.

LANCASTER, CAL.—Representatives of the Southern Sierras Power Company were in Lancaster recently, making preliminary arrangements for this company to enter Lancaster.

SAN FRANCISCO, CAL.—To add to the attractiveness of the principal Chinatown streets, plans are in consideration by the Chinatown Property Owners' Association for the erection of lighting arches along Stockton street and Grant avenue.

POCATELLO, IDAHO.—The Utah Light & Power Company will soon start active operation in building an electric lighting and power system in Downey. A franchise has been granted, and a party of surveyors is now engaged in surveying for the distributing system.

COLFAX, CAL.—D. C. Gillen, who runs the local electric light plant has applied for authority to sell his plant to the Pacific Gas & Electric Company for $12,000. He placed the physical value of the property at $8000 and the remaining $4000 represented good-will and building up the business. His distributing system includes about eight miles of wires.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has submitted bids for furnishing gas and electric light to the city during the coming fiscal year. The rates asked for street and public building illumination are the same, except slight reductions from the existing charges in two items, the net result of which will mean a saving to the city for the year of about $4500.

MARYSVILLE, CAL.—The City Council has granted 50-year franchises to the Oro Electric Corporation and the Great Western Power Company to furnish light, heat and power within the city limits. Each company is to pay to the city 2 per cent of its gross earnings after the first five years. The city reserves the right of using the poles of both companies to stretch the wires of the municipal fire alarm system.

BAKERSFIELD, CAL.—Professor C. L. Cory of the State University, employed as an expert by the city in defense of the 50-cent gas ordinance, now before the Federal Court, announced that the rate fixed by the City Trustees would confiscate the property of the San Joaquin Light & Power Company, and could not be justified in court. City Attorney Laird, after examining the expert's report, said the ordinance would not be defended.

SEATTLE, WASH.—Rufus C. Dawes, vice-president of the Seattle Lighting Company; Henry M. Dawes, Chicago capitalist, and Charles G. Dawes, president of the Chicago Central Trust Company, are backing a proposal to build a large gas works and manufacture coke and other by-products at Seattle. The contemplated plant is to cover about 75 acres of land on the Duwamish River. Several million dollars are involved in the project. It is proposed to have the plant in operation within the next three years.

TRANSPORTATION.

SACRAMENTO, CAL.—The "Steamer Special," to be the fastest train in the Sacramento Valley, joining Chico, Oroville, Colusa, Marysville and Woodland with Sacramento, and making connections with the California Transportation Company's river boats, will be placed in service by the Northern Electric June 13. The new train will cut down the regular time between Chico and Sacramento 40 minutes, making the trip in 2 hours and 20 minutes. The distance between the cities is 90 miles.

SPOKANE, WASH.—An electric interurban line between Spokane and Wenatchee following the tracks of the Great Northern Railroad and tapping the same territory that the Hill road occupies at present is under consideration. Wall street capitalists are said to be back of the enterprise.

TACOMA, WASH.—At a recent election held in Tacoma the proposition to build a municipal electric railway line across the tide flats was carried, but the bonds for carrying the project through, amounting to $87,000, were lost. It is presumed that the next tax budget will provide for building the road.

PLEASANT HOME, ORE.—Trolley wires of the Mount Hood Railway have been strung to Cottrell, on the way to Bull Run. The work of electrifying the line is progressing rapidly between Portland and Bull Run. A considerable force of men is employed, and soon electricity will take the place of steam as motive power.

LOS ANGELES, CAL.—The Pacific Electric Railway Company announces that it will connect Long Beach and Redondo with an electric line skirting the ocean. Rights of way are now being secured, and construction will be started when all the right of way is under contract. The line will be an extension of the present Redondo Beach line, and will be eighteen miles long, costing about $5,000,000. The building of this line will complete a circle for Los Angeles, Redondo and Long Beach.

TULARE, CAL.—Six directors of the Big Four Electric Railway of this city, just elected, represent new capital which will finance the company in the completion of its lines connecting Tulare with Visalia, Porterville and Woodville. The new directors are: John C. Hays, president Mt. Whitney & Yosemite Power Company; John F. Jordan, president Citizens' Bank and the Palace Hotel Company of Visalia; W. A. Zimmerman, president Oregon County Savings & Trust Company of Santa Ana; R. Linder, Wm. Swall and J. R. Hitchcock.

PORTLAND, ORE.—Rapid progress is being made on the extension of the Woodstock car line from East Forty-sixth street, on Woodstock avenue, to East Fifty-seventh street, and the track will be completed in June. The Portland, Railway, Light & Power Company is preparing to lay double tracks on East Forty-first street, between Yukon street and Woodstock avenue, where a hard-surface pavement will be put down this year. Both places mean the construction of a mile and a half of new car track in the Woodstock district. The contractor has started grading on East Forty-first street.

STOCKTON, CAL.—Officials of the Tidewater Southern Railway report relative to the work of electrification of its system that all the equipment material for the entire line between Stockton and Modesto is on hand or covered by orders that will insure early delivery. Workmen are beginning to string the trolley wire. Poles are distributed as far as Escalon and erected over a distance of ten miles out, and brackets are ready for nearly the same distance. The work of building the $2000 depot at Escalon is well along. In Modesto the track has been laid on Ninth street. The cars are being painted in the Eastern shops, and should be delivered on time. As soon as the work of electrification is completed the Tidewater will call for bids on the extension to Turlock, involving about ten miles of road. Steel for the bridge across the Tuolumne River is framed and ready for

shipment. The Tidewater has expended for permanent improvements during a period of ten months $446,886.30.

SEATTLE, WASH.—The officials of the Lake Burien electric railway extending from Lake Burien to Spokane avenue, Seattle, a distance of seven miles, have made an offer of the road to the City of Seattle. The council thinks favorably of the proposition, and has asked the corporation counsel to prepare the tender in proper form, and have it signed by the officials of the company. The tender will set forth terms upon which the road is taken, how it will be operated, etc. If the road becomes the property of the city it is the intention to build an extension from Spokane avenue to Jackson street, a distance of about 1¾ miles, thereby connecting with the municipal line under construction.

OAKLAND, CAL.—The suburban electric lines of the Southern Pacific Company in Oakland, Alameda and Berkeley are to be separated as an operating organization from the steam lines about the bay, according to an announcement made by officers of the company. Directly in charge of the electric organization will be a local manager, to be appointed within a few days. Under him, W. H. Norton, at present assistant superintendent of the Western division, will supervise electric train operation. Paul Shoup, president of the Southern Pacific's big Southern California subsidiary, the Pacific Electric, and as such general overseer of all the Southern Pacific's electric properties, will remain the executive head of the transbay system.

FRESNO, CAL.—As soon as the right of way deeds can be cleared, the Fresno Traction Company will start construction of a railroad line from Muscatel to Biola, according to an announcement made by F. W. Webster, general manager. The Biola line will be 8½ miles in length, from Biola to the townsite of Muscatel, on the main line of the Southern Pacific. It will be a motor road at first, although it is the intention of the traction company to electrize it within a very short time after its completion. The route for a time, by motor, will be from Biola to Muscatel and thence down the main line of the Southern Pacific to the Southern Pacific depot in Fresno. When the line is put under wire, it will be extended from Muscatel to connect with the new line to the San Joaquin River, which the Fresno Traction Company will build. Work on the permanent survey for the San Joaquin River line was started recently, under the direction of Chris. Jensen. Instructions have been given by the traction company to its attorneys to apply for a franchise from the supervisors at once, and application for permission to build will be made immediately to the State Railroad Commission.

TRANSMISSION.

VISALIA, CAL.—The formal opening of the Mt. Whitney power plant No. 3, on the Kaweah River, was held last week. The new plant completes a circuit of three, and this is the Mt. Whitney's fifth plant in this county.

PORT ANGELES, WASH.—The Olympic Power Company has closed a contract for the rehabilitation of its plant on the Elwha River, which was damaged last fall by the blowing out of the dam. The new engineers and contractor say that it will be ready for operation in about five months.

PRESCOTT, ARIZ.—Ralph Cameron has announced that plans are practically completed for the establishment of a giant electric plant. The company, of which Cameron will be a prominent official, will be capitalized for $15,000,000, and is designed to furnish cheaper electrical power for nearly all of Arizona. Although not definitely settled, the plant will probably be located in the Grand Canyon.

PORTLAND, ORE.—The Pacific Power & Light Company has temporarily discontinued work on its hydroelectric plant at Hood River, Ore., which is to cost about $500,000 when completed. About $50,000 has been spent in preliminary work, and construction will be resumed in the fall. Officials of the company state that work was stopped because it was found that the money to be used in construction of this plant could be employed more profitably in betterments to several of the other operating plants of the company. The nine-mile concrete canal to carry water to the new generating station being built at Natches, on the North Yakima River, has been completed and a 5000 h.p. hydroelectric station is under construction there. Later a second station of 3500 h.p. is to be built at Natches if plans now under consideration are carried out.

PORTLAND, ORE.—The adoption of the new city charter, with the commission form of government, gives the commission practically full power over all utilities operating in the city. The principal utilites in Portland are the Portland Railway, Light & Power Company, controlled by E. W. Clark & Co.; the Portland Gas & Coke Company, one of the American Power & Light properties controlled by the Electric Bond & Share Company, and the Northwestern Electric Company, a new concern, not yet in operation, controlled by the Fleishhacker interests in San Francisco. The new charter gives to the city commission the general supervision and power of regulation of all public utilities within the city and of all persons and corporations engaged in their operation. The charter provides for as rigid accounting from public service corporations as it does of city officials and employees. Power is given to the city to own and operate utilities, or any plant or enterprise. The city may construct its own utilities, or it may take over any privately owned public utility, paying therefor by the issue of public utility certificates, secured by a mortgage on the utility purchased, and not a general obligation of the city. The commission is given power of compulsory investigation of corporations, and may say what are reasonable rates for service of public utility corporations. Reports must be made regularly by corporations, and failure to do so is punishable by fine or imprisonment. The commission is given power to make its own rules for carrying out all regulations provided in the new charter, and can forfeit the franchise of any utility disobeying these rules. Franchises are to be regarded as property and taxed as such. No franchise is to be granted for a longer period than 25 years, and no exclusive franchise shall be granted. Franchises may be used only by the interest securing it. There is to be a common user privilege in all franchises granted, and a referendum may be invoked any time within 60 days after passage of a franchise on a petition signed by 2000 voters.

TELEPHONE AND TELEGRAPH.

SOUTH PASADENA, CAL.—Plans have been completed by Norman F. Marsh for a brick telephone exchange building, to be erected on Rollins street, for the Home Telephone Company, which was recently granted a franchise by the Board of Trustees.

SACRAMENTO, CAL.—The controlling interest in the California and Oregon Company has been purchased by W. E. Hill, Scott Hendricks and A. J. Matthews of Sacramento. The new management has secured a lease for a period of years of the California and Oregon Telephone Company's lines between Reno and Lakeview, Ore.

ALAMEDA, CAL.—The result of a citizens' mass-meeting called by the City Council for a discussion of the granting of a continuance of the franchise of the Pacifiic Telephone and Telegraph Company, which has expired, was the ordering of the drafting of a franchise ordinance by the public utilities committee for a working basis for the council. The ordinance will include free use of telephones by the city, a fifteen-year renewal, a payment of 2 per cent of the gross revenue of the company to the city, and a mutual use of poles and conduits.

ALPHABETICAL INDEX TO ADVERTISERS

Fuse Boxes
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Fuses, Miscellaneous
General Electric Company
Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
Benjamin Electric Mfg. Co.
Johns-Manville Co., H W.
Pacific States Electric Co.

Hangers, Cable
Standard Und. Cable Co.

Heating Material, Including Soldering Irons, Sad Irons, Etc.
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Hoists, Electric
Fairbanks, Morse & Co.
Sprague Electric Works

Hose, Armored
Sprague Electric Works

Hoods, Street
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Glass
Hemingray Glass Company
Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, High-Tension
General Electric Company
Johns-Manville Company
Ohio Brass Company
Pacific States Electric Co.
Pierson-Roeding Company
"Pittsburg," Elec. Agen. Co.
Thomas & Sons, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Porcelain
General Electric Company
Johns-Manville Co., H. W.
"O. B. Hi-Tension," Holabird-Reynolds Co.
"Victor,"Pierson,Roeding&Co.
Pacific States Electric Co.
Pass & Seymour, Inc.
"Pittsburg," Elec. Agen. Co.
Thomas & Sons Company, R.
Western Electric Company
Westinghouse E. & M. Co.

Insulators, Suspension
"O. B. Hi-Tension," Holabird-Reynolds Co.
Pacific States Electric Co.
Pass & Seymour, Inc.
Pierson, Roeding & Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

Insulators, Wood Knobs
Blake Signal & Mfg. Co.
Ohio Brass Company

Insulating Material
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Pacific States Electric Co.
Standard Und. Cable Co.
Westinghouse E. & M. Co.

Jobbers
Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
Fort Wayne Electric Works
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
General Electric Company
Pacific States Electric Co.

Lamps—Incandescent, Tungsten, Gem, Tantalum and Carbon.
Brilliant Electric Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Jos. Thieben & Co.
Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

Launch Lighting Outfits
"Dayton," Elec. Agencies Co.

Lightning Arresters
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Line Material, Railway
General Electric Company
Johns-Manville Co., H. W.
Ohio Brass Company
Western Electric Company
Westinghouse E. & M. Co.

Lubricants
Nason & Co., R. N.

Machinery, Mining
Fairbanks, Morse & Co.
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Magnetos, Testing
Holtzer-Cabot Co.

Magnets, Lifting
The Cutler-Hammer Mfg. Co.

Meter Testing
K-P-F Electric Co.
Weston Elect. Inst. Co.

Meters, Ammeters and Volt
American Ever-Ready Co.
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis, R. R. Poppleton, W. M. Price Co., A. T. Egan.
Fairbanks, Morse & Co.
General Electric Co.
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

Pipe, Riveted Steel
Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
Western Pipe & Steel Co.

Piping Installation
Mannesmannrohren-Werke
Pittsburg Piping & Equip. Co

Plugs, Flush
General Electric Company
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co
General Electric Company
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M Co.

Plugs, Stage
General Electric Company
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Boiler Feed
Fairbanks, Morse & Co.

Pumps, Centrifugal
Byron Jackson Iron Works.
Fairbanks, Morse & Co.

Pumps, Deep Well
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Vacuum
Simonds Machinery Co.

Push Buttons
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Wagner Electric Mfg. Co.
Westinghouse E. & M. Co.

Reflectors
Holophane Works of G. E. Co.

Repairs, Electrical
K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 807 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 578 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Mannesmannrohren-Werke
San Francisco, Rialto Bldg.

McGlauflin Mfg. Co.
Sunnyvale, Cal.

Nason & Co., R. N.
San Francisco, 151 Potrero Ave.

National Con. & Cable Co., The
San Francisco, Rialto Bldg.
Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Ohio Brass Co.
San Francisco, 523 Mission.
Los Angeles, 372 Pac. Elec. Bldg.
Seattle, 524 First Ave. So.

Okonite Co.
All Jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pass & Seymour
San Francisco, Rialto Bldg.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
San Francisco, Monadnock Bldg

Poppleton, R. R.
20 N. 12th St., Portland. Ore.

Post Co., The Frederick
San Francisco, 135 Second

Price Co., W. Montelius
Seattle, Wash.

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg.

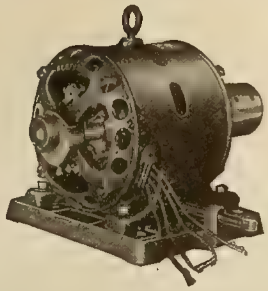
Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Pacific States Electric Co.
Pass & Seymour.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill,"Pierson, Roeding & Co
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.
Switches, Push Button
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Wagner Electric Mfg. Co.
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.
Tubes and Bushings
Ohio Brass Company
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee,"Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co.,The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Wagner Electric Mfg. Co.
San Francisco, Rialto Bldg.
Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758W.Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas&Elec. Bldg.
Los Angeles, 811 I. N. Van Nuys Bldg.
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 PacificBlg.
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco, 682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

You will some day better appreciate the advantages resulting from the liberal installation of

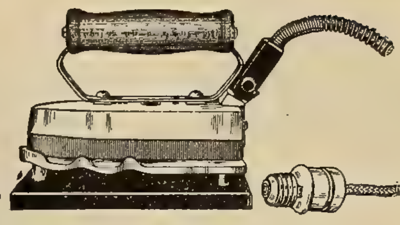
Century SINGLE PHASE MOTORS



We offer you today every opportunity of becoming more familiar with them. Are you ready?

They are built in sizes of ¼ to 40 Horse Power, for any frequency between 25 and 140 cycles.

CENTURY ELECTRIC CO.
19th and Olive Sts., St. Louis, Mo.
Western Sales Offices and Stocks at San Francisco, Los Angeles, Portland, Seattle, Spokane, Salt Lake City



Simplex Electric Irons

hold their supremacy because THEY SATISFY EVERYBODY

Unique in that the heater (covering the entire ironing surface, actually **is the bottom** of the iron. Hence more and quicker heat for less current than any other iron of equal capacity. Throughout of Simplex Quality—efficiency with comfort to the user.

Do you know about **the range** that has revolutionized electric cooking? Send for the new book:

"It Means Freedom"

It will help you.

Simplex Electric Heating Co.
612 Howard Street, San Francisco
Chicago, 15-21 S. Desplaines St. Cambridge, Mass. Belleville, Ont.

HEMINGRAY

HIGH EFFICIENCY INSULATORS

You may not know it, but it is a fact that these are the most successful high efficiency insulators yet devised. **See the Teats on the Petticoats,** they prevent creeping of moisture.

HEMINGRAY GLASS CO.
Covington, Ky., and Muncie, Ind.

REPRESENTED ON THE PACIFIC COAST BY 4

Electric Appliance Co., San Francisco
Frank Darling & Co., Vancouver, B. C., Canada
Pacific States Electric Co., Los Angeles
Fobes Supply Co., Portland, Oregon

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE—Two steel tanks, 6 ft. by 12 ft., with convex heads; sheets ½ in. and heads ⅜ in. These tanks are new and only partially built. A bargain. San Francisco Disposal Co., Evans and Keith Streets, San Francisco.

FOR RENT.—1270 square feet storeroom; 10-foot ceiling; on Natoma street, near New Montgomery; use of 11-foot 2-ton elevator; rent $25.00 per month. Address Box 18, Journal of Electricity, Power and Gas.

Because it is the Best it is the Cheapest

Sterling Roofing

We have the sole agency for Sterling Roofing and can recommend it for permanency where roof is exposed to exceptional conditions. It will add distinction and ornamentation to your buildings.

BONESTELL & CO., Agents
118 FIRST STREET - SAN FRANCISCO

E. C. HUGHES, PRESIDENT ADOLPH MEESE, SECRETARY

E. C. HUGHES CO.

PRINTERS -- ENGRAVERS -- BOOKBINDERS
LET US FIGURE ON YOUR CATALOGUE AND OTHER PRINTED MATTER
Printers and Binders of the Journal of Electricity and other Publications
147 to 151 Minna Street, San Francisco. Phone Kearny 806

This Trade Mark The Guarantee of Excellence on Goods Electrical.

A Luxury once reserved for the Rich
Now made Universal by Electricity

This illustration and heading for the fourth advertisement of the USE ELECTRICITY CAMPAIGN will appear June 7th in the Saturday Evening Post and Literary Digest.

But this advertisement is not limited to G-E Fans. The summer uses of G-E Flatirons and other electric heating and cooking devices are illustrated and described. The advantages of Edison Mazda Lamps for residence lighting, sign lamps for commercial use and battery lamps for the electrically lighted automobile are likewise shown by word and picture.

In fact, this advertisement emphasizes a few of the many advantages of *complete* electric service. And interested readers are directed to their "electric dealer or lighting company" for the goods themselves.

This advertisement is another example of the continuous co-operation given the agent for G-E products.

General Electric Company

Largest Electrical Manufacturer in the World

General Office: Schenectady, N. Y.

Pacific Coast Sales Offices in San Francisco, Los Angeles, Portland, Seattle and Spokane
Rocky Mountain Sales Offices in Denver, Colorado; Salt Lake City, Utah; and Boise, Idaho

4239

The Trade Mark of the Largest Electrical Manufacturer in The World.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXX No. 23 | SAN FRANCISCO, JUNE 7, 1913 | PER COPY, 25 CENTS

Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages, 9, 10.

PIERSON, ROEDING & CO.

ELECTRIC RAILWAY AND TRANSMISSION EQUIPMENT

Steel Towers and Poles

For Transmission Lines

In your entire transmission system no item is of more importance than the right selection of towers. We solicit your inquiries.

Send us data covering your transmission lines, and we will be glad to submit suitable designs and prices of towers for your requirements.

Pierson, Roeding & Co.

San Francisco Portland Seattle Los Angeles

Special Pacific Coast Representatives

AMERICAN BRIDGE COMPANY

OF NEW YORK

Investigate it—

"Phono-Electric" TROLLEY WIRE

Put up a section on the hardest spot in your line; watch it; make your own comparison, then you will know that "Phono-Electric" is the most economical wire to use—It is the practical test that counts.

BRIDGEPORT BRASS COMPANY, Bridgeport, Conn.

PIERSON, ROEDING & CO.

Phono-Electric

PACIFIC COAST AGENTS

San Francisco Seattle

Los Angeles Portland

Phono-Electric

LOCKE

PORCELAIN INSULATOR No. 408-A

(IN SAN FRANCISCO STOCK)

Line Voltage	27000	Diameter	8 inches
Test Voltage	80000	Pin Hole	1⅜ inch
Rain Test	50000	P'k'd Weight	6 lbs.
Leak Distance	13¾ in.	No. per bbl.	30

The Locke Insulator Mfg. Co.

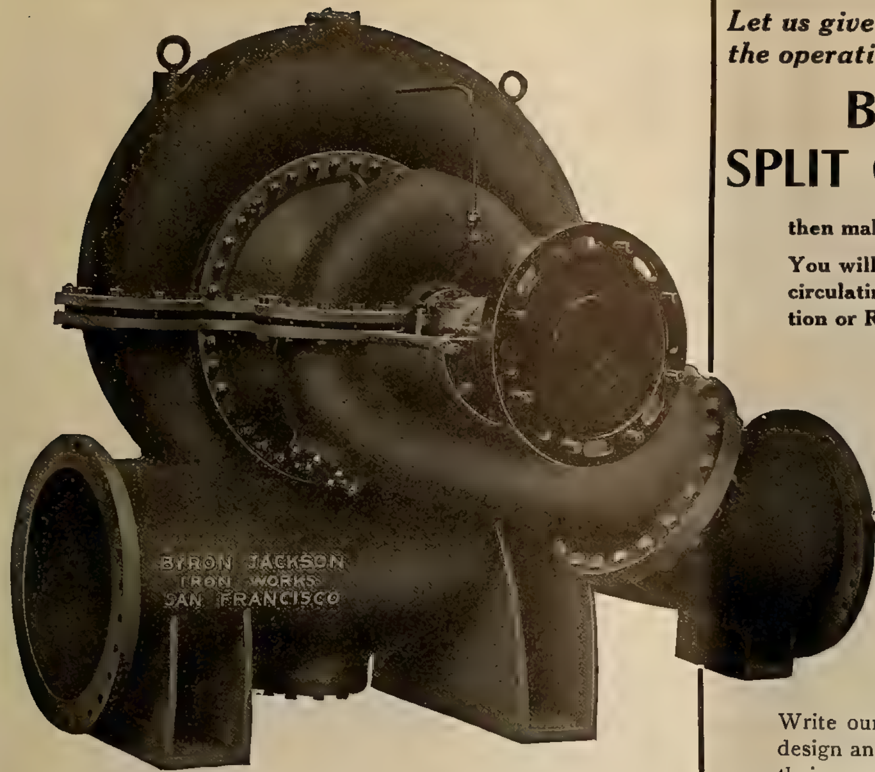
Victor, N. Y.

PIERSON, ROEDING, & CO.

PACIFIC COAST AGENTS

San Francisco Seattle

Los Angeles Portland



Jackson Horizontally Split, Type "S"
Large Capacity Centrifugal Pump

Ask for Catalog No. 35.

Let us give you figures on the operating cost of

BYRON-JACKSON SPLIT CENTRIFUGAL PUMPS

then make your comparisons.

You will find them the most economical for the circulating systems in the Central Station, Irrigation or Reclamation project.

Arranged for Double or Single Line Suction

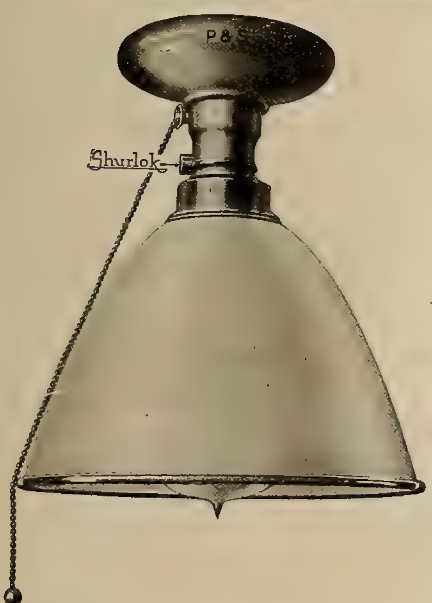
Direct Connected to Engines or Motors

Compact—High Efficiency

Write our engineering department for details of design and economic features. You will profit by their experience and save time and money.

BYRON JACKSON IRON WORKS, INC.

San Francisco, 357-361 Market St.
Los Angeles, 212 North Los Angeles St.
Works: West Berkeley, Cal.



In Chicago

there is a hotelman who was pestered to distraction with the constant expense of replacing stolen Tungsten lamps.

That was a daily occurrence, but often the frugal tourist would "swipe" a shade or two, as well.

It is all a thing of the past now—the sockets are the Shurlok kind.

Theft is impossible, and the saving effected will pay for the installation within a few months.

The old trouble, due to guests attaching flatirons to the sockets, has been done away with.

Send for descriptive bulletin, and then see the hotels in your town.
The coupon is here for your convenience.

Pass & Seymour, Inc.

Main Office & Works
Solvay, New York, U. S. A.

NEW YORK CITY	SAN FRANCISCO	CHICAGO
178 Fulton St.	Rialto Bldg.	700 West Jackson

DENVER SALES AGENTS, B. K. SWEENEY ELECTRICAL COMPANY

PASS & SEYMOUR, Inc., SOLVAY, NEW YORK
Please send free copy Shurlok booklet and Catalog 20.
Name ....
Address ....
City ....
State ....
Coupon No. 123.

JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX SAN FRANCISCO, JUNE 7, 1913 NUMBER 23

ELECTRIC CONDUIT SYSTEM OF THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION

BY HENRY BOSCH, JR.[1]

The grounds of the Panama-Pacific International Exposition comprise 625 acres in the Harbor View section of San Francisco, occupying a natural amphitheatre overlooking San Francisco Bay and its Golden Gate entrance from the Pacific. These grounds include part of the United States military reservations, the Presidio at one end and Fort Mason at the other. They extend over two miles on the water front and are one-half mile wide.

lessons instead of words what mankind is and does, and seeks to do in 1915.

The Concessions Section will contain the amusement features of the Exposition and will provide entertainment in its every sense and form. This section is in the eastern portion of the grounds, convenient to the heart of San Francisco.

The slope of this natural site is uniform, the highest ground lying in the east wing. There is a

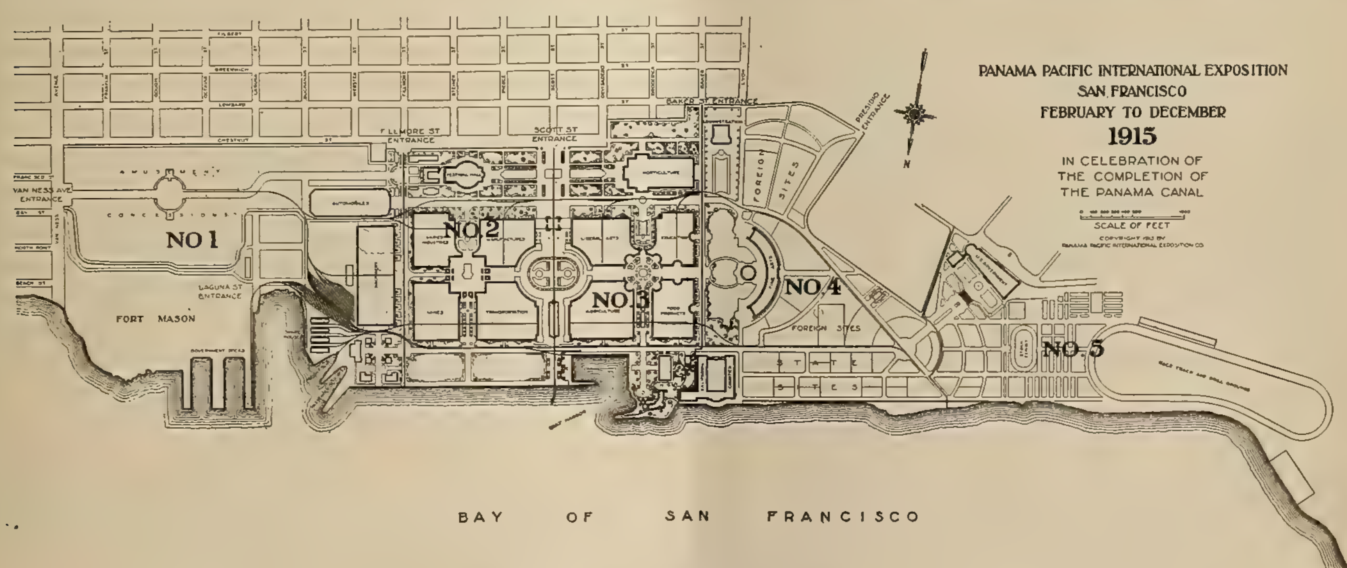


Fig. 1. General Layout of Exposition.

difference of about 70 ft. between this ground and the average elevation found in the south gardens. The Exhibit Buildings section occupies the center basin and has a change of grade of about 12 ft. in its slope from the south gardens to the north esplanade.

The site is divided into three parts: National, State and Foreign Sites; Exhibit Buildings Section, and the Concession Section.

The National, State and Foreign Sites section, located in the Presidio, will be devoted to diplomatic, state and social functions.

In the center or Exhibit Buildings section will be located the exhibit palaces. These structures will be grouped about courts and so connected that visitors may traverse all without passing from under cover. Here will be found the exhibits brought from all parts of the world to tell the student and thinker by object

To prepare the grounds many buildings had to be disposed of, some by wrecking and others carried bodily to other foundations prepared to receive them outside the grounds. Much of the low ground was brought to grade by means of dredgers. A fill of 1,600,000 cu. yds. was made in this manner. The soil consists mainly of beach sand, and a water table will be found within four feet of certain finished grades in that section to the extreme north and west.

[1]Chief Draftsman Mech.—Elect. Dept.

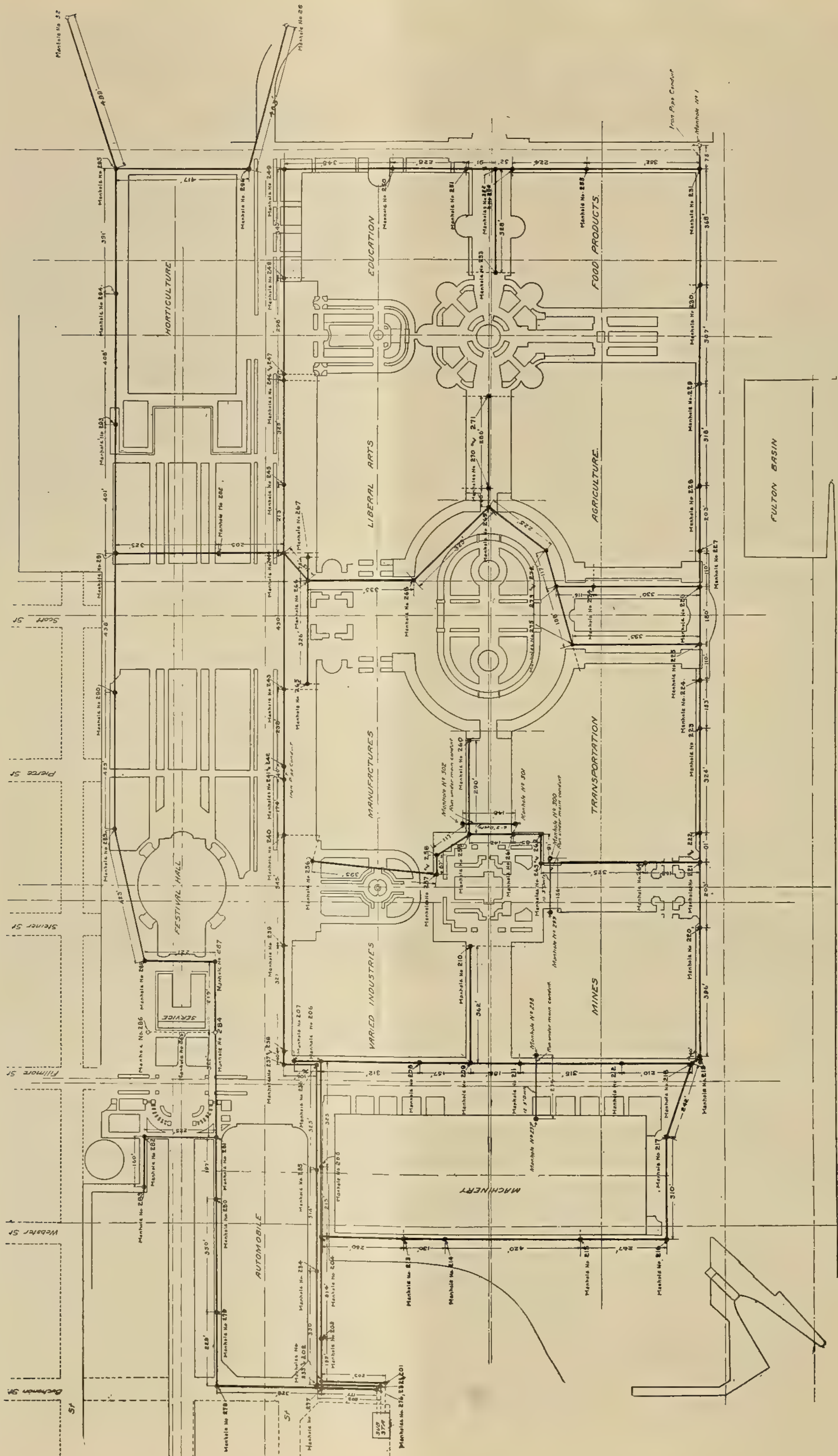


Fig. 2. Conduit Layout for Exhibit Building Section.

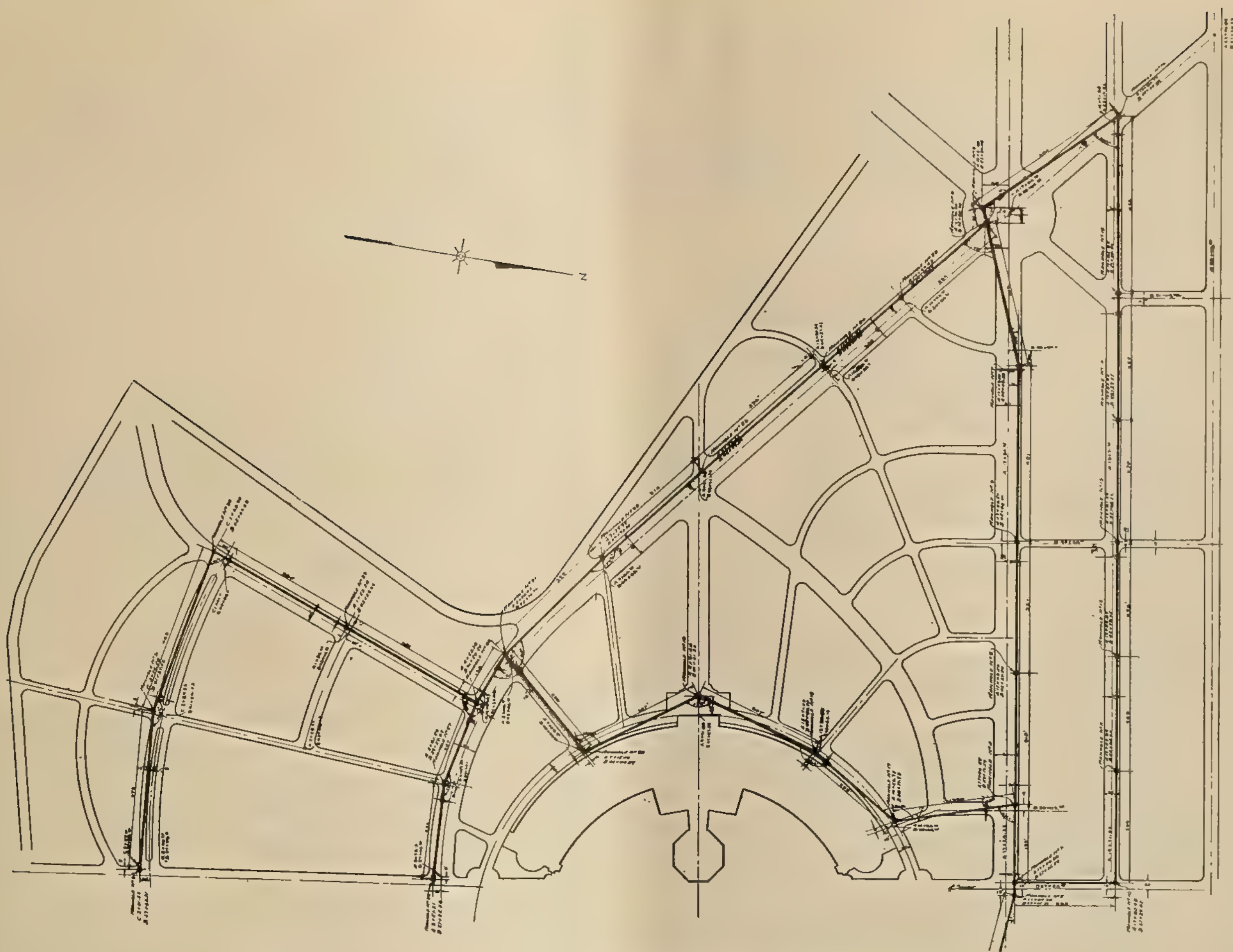


Fig. 3. Conduit Layout for National, State and Foreign Section.

First class drainage will be provided by means of a carefully planned sewer system installed by the exposition company. These sewers will tap standard city sewers, with the exception of the drainage system installed in the Presidio grounds. This will be lifted from a specially constructed sump and pumped into the bay by means of motor-driven centrifugal pumps. This installation will have a capacity of 6,000,000 gallons per 24 hours.

Unlike other expositions, the period of time elapsing between the opening and the closing of the gates will extend over ten months, opening on the 20th day of February, 1915, and closing on the 4th day of December of the same year, making it a winter to winter event. During this entire period electric service will be furnished to all parts of the grounds. This service will be maintained through underground conductors, with minor exceptions, and it is the purpose of this article to describe the electric conduit installation involved.

To distribute electric energy economically, avoid unsightly construction, maintain good service, and keep the whole in accord with the temporary construction expected of such an event, left the designers to face the problem—How shall it be installed?

A general study of the grounds showed that with few exceptions, all of the exhibit buildings are grouped in close proximity, and the Concessions Section reasonably close, the most remote section lying in the Presidio.

From an economical point of view the general scheme of the exposition as a whole seemed to have been laid out most carefully with consideration to distribution of electric energy. The point at which energy could be fed into the system with greatest convenience to the central station furnishing this energy, happens to be the logical point with reference to the load. Automatically as the feeder lengths increase, their loads decrease.

Referring to Fig. 1, and commencing at the extreme east, we have, as the general layout shows, the Concessions Section with an area of about 45 acres, which it is assumed will require approximately 2500 kw. Adjacent to this section follows the Exhibit Buildings Section with approximately 3,500,000 sq. ft. of exhibit area, as well as the main entrances, spectacular lighting effects, towers, etc., the day load being assumed at practically 4500 kw., which it is expected will shift to decorative lighting and effects after the closing hour of the exhibit buildings.

The States and Foreign Sites Section lies well to the west, consisting of approximately 100 acres, not including that area devoted to stock exhibits, race course, etc. The government exhibit will be located in this section; 2500 kw. is assumed a fair requirement for this section.

With a main source of feed for the system located between the Concessions and Exhibit Buildings Section all feeders are reasonably short, the load being within easy range except the lengthy runs to the

States and Foreign Sites. A study of the possible load expected indicated a probable peak of 12,000 kw. when motor, light and grounds lighting overlap during dark periods.

It might be of interest to add that the loads assumed for the Exhibit Buildings and Concession Section were not made on the basis of requirements of past expositions, owing to the recent introduction of the tungsten lamp and other devices perfected since the occurrence of an exposition of equal magnitude.

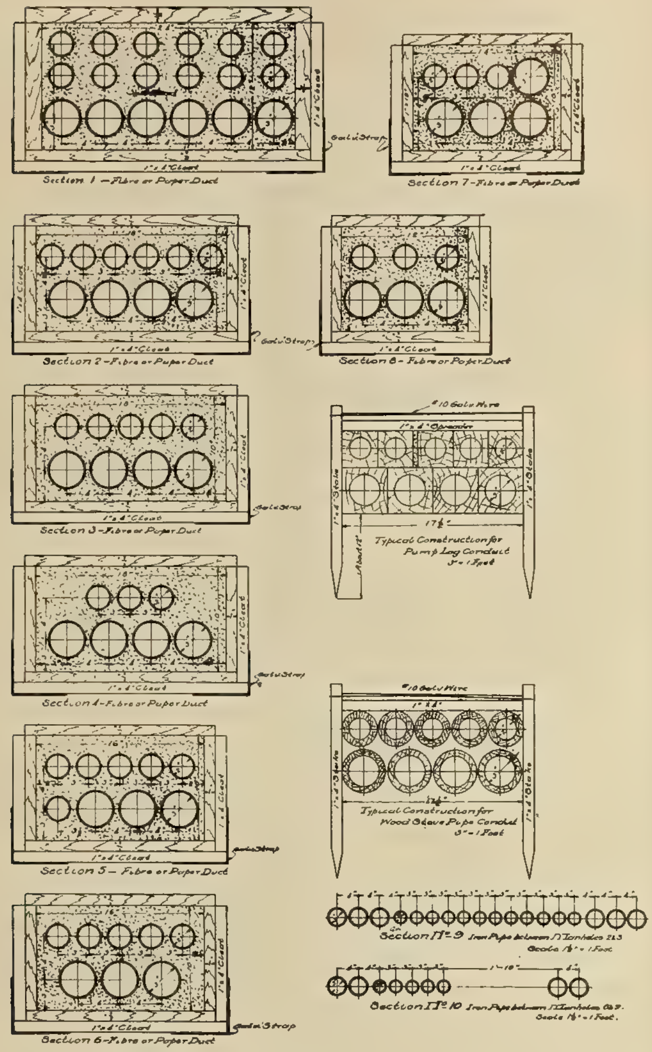


Fig. 4. Typical Conduit Cross-Sections.

The load for the States and Foreign Sites Section was based on a proportionate part of total ground area being allotted to buildings, allowing one watt per square foot of building area.

After due consideration it was decided that the primary distribution system should be 3-phase, 4150 volts a.c. with grounded neutral. Direct current at 250/125 volts three-wire will also be distributed to certain of the exhibit buildings, but its distribution will not be considered at this time.

The general architectural and landscape scheme does not lend itself to electric distribution being placed where it might be visible. To traverse the roofs of buildings with 4000 volts left chance of hazard to buildings as well as human life. The headroom beneath the main floors of buildings is insufficient for the racking of feeders. In a few instances the main floors in part rest directly on the ground.

To avoid flooding or trouble from excessive surface water, since the drainage system is close to the ground surface, the transformers themselves will be placed above ground level. Subway transformers will not be used if possible to avoid them.

With overhead construction eliminated, the problem remained—How should all conductors be placed underground in an installation which must be inexpensive, safe, flexible, permit sectionalizing, and, most important of all, to permit the pulling in and withdrawal of cable at will?

With a well designed conduit system little capital need be tied up in cable lying idle awaiting such time as service might be required. The advantage in using a conduit system of such description and more particularly for the purpose here intended, prompted its use. The use of armored cable in preference to standard paper and lead cable was seriously considered. While its first cost was higher than the latter, the ease with which it could be laid was quite attractive.

During the constructive period of the exposition the grounds, literally speaking, will be torn to pieces. Little protection beyond the armor itself would be afforded the cable. Further it would require that sufficient cable be installed at that time when the landscape engineers are preparing their beds to ensure their work from being molested after once completed. This prompts a heavy first investment and one that brings no revenue for months to come.

A fault in an armored cable is quite difficult to find. The making of splices are tedious, and a serious factor is its low salvage value. The cost of resurrecting is high and the general use not as common with power companies as paper and lead cable.

With the fact in mind that a conduit system permits the drawing of cable at will, the distribution system was planned, and to insure the utmost isolation, the "grounds" were divided into three sections, namely, Concessions, Exhibit Buildings, and States and Foreign Sites.

Figs. 2 and 3 show the general layout of the system. This layout is capable of routing by means of emergency tie cable, any available power, and transferring it to another section. As an instance—power intended for the States and Foreign Sites Section may be diverted through an emergency tie and used to feed the north or south feeders of the Exhibit Section, or vice versa. The cable known as the gate cable may be tied in with either the North, South, States and Foreign Sites Section, or into an emergency feeder of the Concessions Section. This will permit the highest efficiency of installed cable. Copper may be shifted (electrically) with load as occasion might require.

In selecting a suitable conduit system, Valentine, Pump Log, Paper Duct, Wood Fibre Duct and Vitrified Clay Duct were considered. Figs. 4 and 5 show typical cross sections and various alternates called for in advertising for bids. The opening of bids decided that wood fibre duct should be adopted. These figures show the method that will be used in installing wood fibre duct. This box or trough construction will extend between manholes, and varies in dimen-

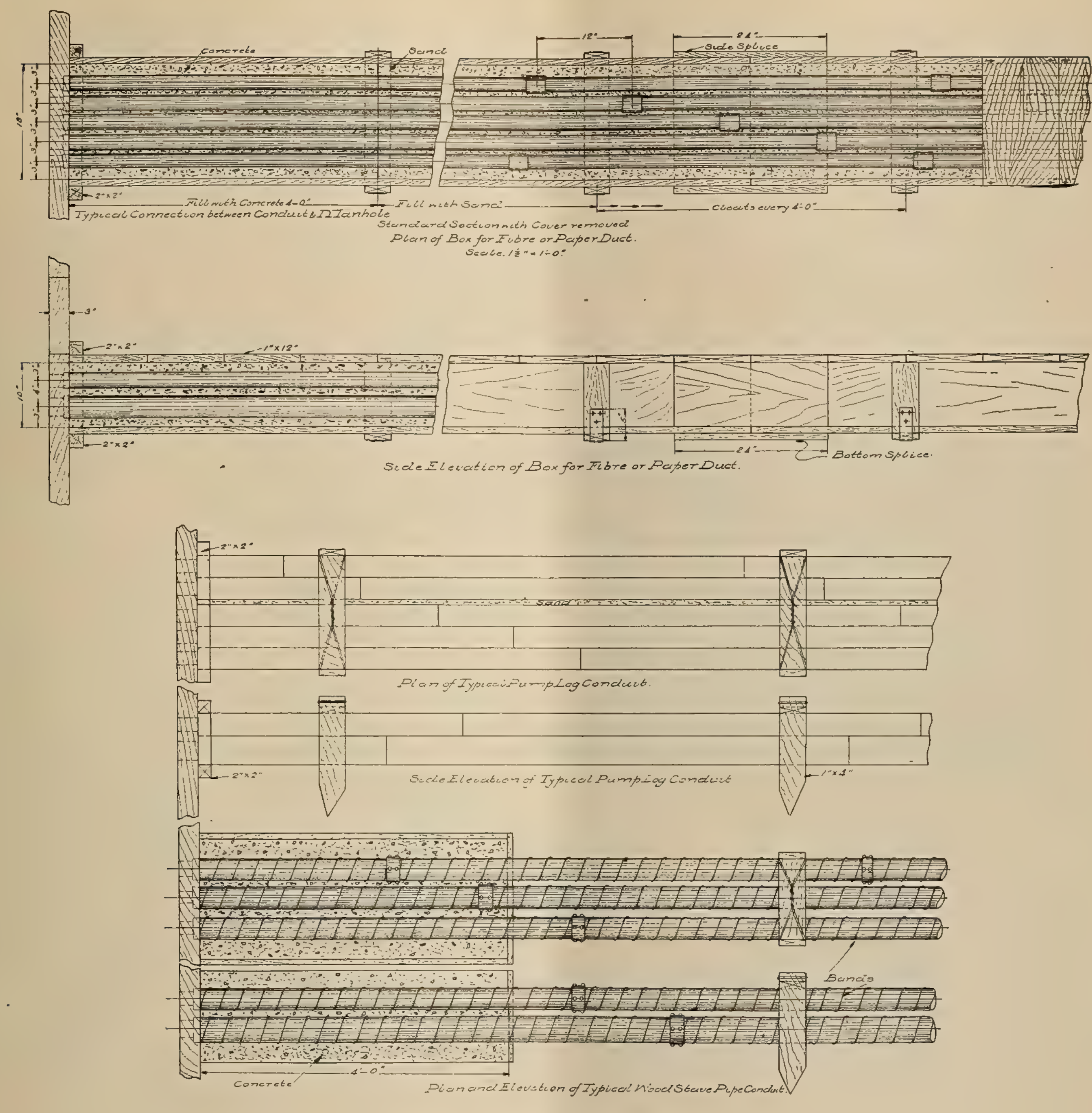


Fig. 5. Typical Conduit Section.

sions to suit the amount of duct required for any particular run. The duct will be aligned by filling this box with sand.

At the point of entrance to manholes the side planking will be bored and counterbored to receive the duct and the box will be filled with concrete for a distance of 4 ft. from each manhole, using gravel or screenings to permit ease of pouring. This box or trough will be covered with planking, well nailed and running across the short dimension of the box. The bottom boards will be reinforced by means of splice plates and tied together with corner straps of sheet metal.

Iron pipe will be used where it is required to cross over existing interferences, such as sewers and water pipes. In several instances these obstructions lie within 18 in. of the finished surface.

Concessions Section.

In the Concessions Section to date there is contemplated approximately 1300 trench feet of conduit consisting of 6500 duct feet of 2 in., and 5200 duct feet of 3 in. wood fibre duct. These ducts are encased in wood construction as described above, in sections ranging from three each of 2 and 3 in. duct to twelve 2 in. and six 3 in.

This conduit will be placed at an average depth of 2 ft. 8 in. from the bottom of box to surface of finished road, or 2 ft. 4 in. to center of lowest duct.

Exhibit Buildings Section.

Approximately 25,000 trench feet of conduit will be required for the Exhibit Buildings Section, consisting of 281,000 duct feet of 3 in. wood fibre duct and 1700 duct feet of 3 in. black iron pipe. Of this amount

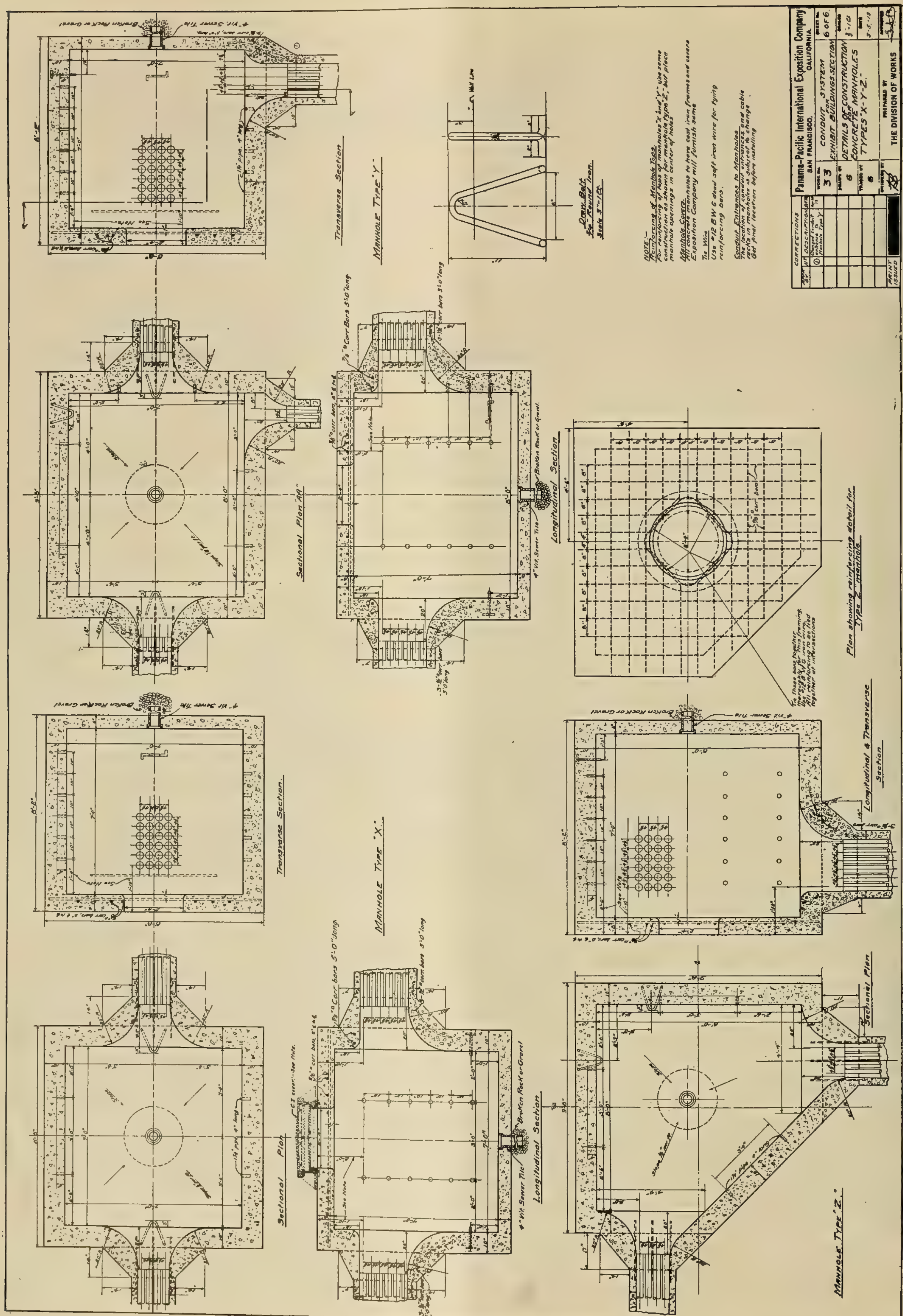


Fig. 6. Design for Concrete Manhole.

of conduit, 2700 conduit feet, or 59,300 duct feet will be laid in standard concrete construction; the remainder, excepting the iron pipe, will be installed in the adopted box construction.

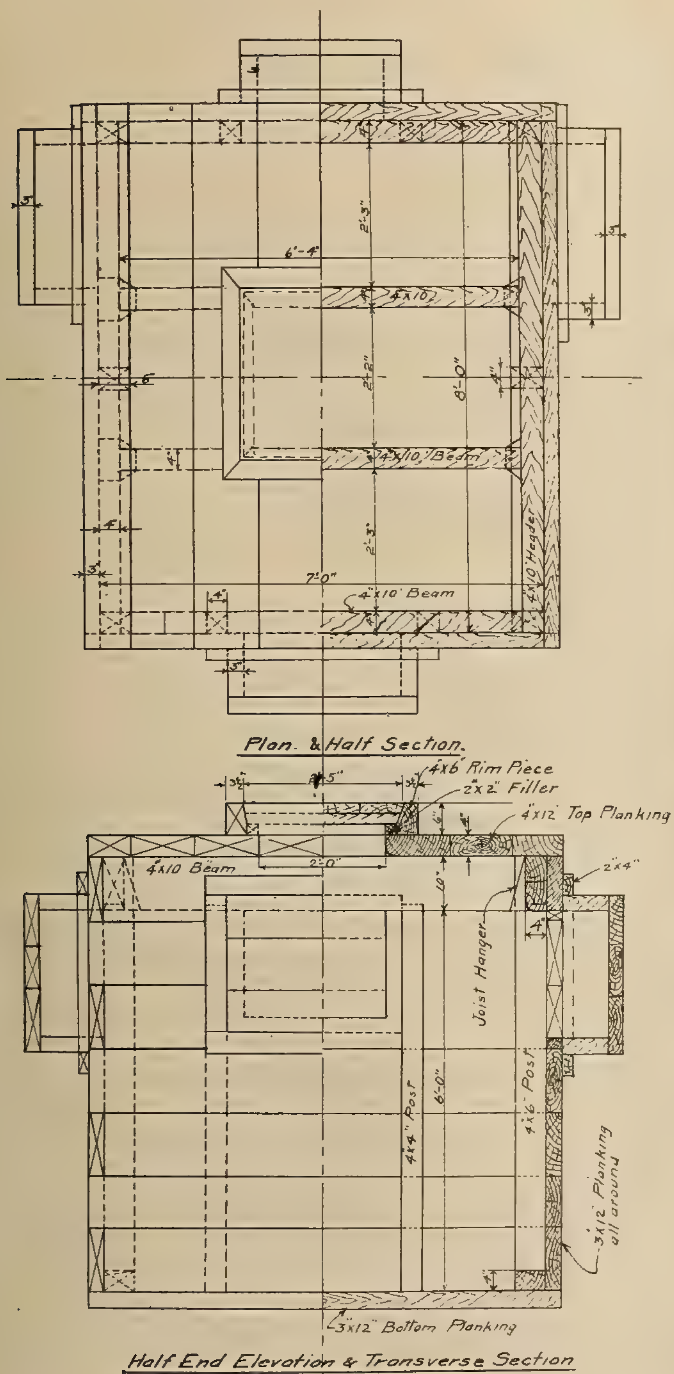


Fig. 7. Design for Wooden Manhole.

The average depth of the concrete construction will be 4 ft. 3 in. from the center of lowest duct to surface of finished road.

The wood construction will run about 2 ft. 8 in.

The cross section of this conduit installation will run from 4 wide 3 high to 4 wide 6 high in the concrete construction and from 2 wide 2 high to 7 wide 3 high in the wood construction.

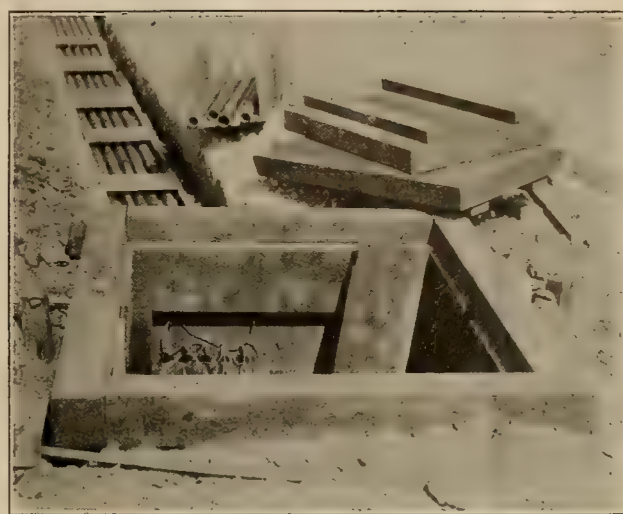
States and Foreign Sites Section.

There will be 10,000 trench feet of conduit in this section composed of 2 in. and 3 in. wood fibre duct with ⅛ in. walls and slip sleeves. It will require approximately 41,000 duct feet of 2 in. and 31,000 duct feet of 3 in. duct. The average section will be 3 ducts wide and 2 ducts high. This duct will be protected by installing it in the wood box construction already described.

Manholes—Type and Design.

In the general system there will be approximately 150 manholes. Thirteen of this number will be of standard concrete construction with cast iron covers. The remainder will be of wood construction.

The concrete manholes will be built in three different types—straightaway, corner, and tee, the sizes varying from 7 x 7 x 7 ft. to 8 x 8 x 7 ft. These holes are designed for heavy duty, both mechanically as well as electrically. They will be located in that section of the system near the power house and exposed to severe traffic conditions, being adjacent to the Palace of Machinery and the railroad yards.



Typical Wooden Manhole.

Owing to the amount of duct leading into the power station, twenty-four duct was decided the limiting feature of any one conduit run. This type of hole will conveniently accommodate this amount of duct or cable. The design of these manholes is shown in Fig. 6.

The type of manholes used in the Concessions and Exhibit Buildings Section is shown in Fig. 7. There are five different types of this construction varying in size from 5 x 6 ft. to 7 x 8 ft. and from 5 to 6 ft. deep, being designed for a concentrated load of 6000 lbs. The entrance will have an opening 24 x 26 in. and the cover is so designed that the lower plank of same will positively place itself as designed when replaced.

Shaped as they are it will be impossible for covers to drop into manholes—a very desirable feature. Lifting ears are provided which will facilitate their removal.

In the States and Foreign Sites Section, manholes of shallow construction will be required due to the depth at which standing water is to be found. Fig. 8 shows this type of design. To avoid encountering the water table all manholes in this section will be but 4 ft. deep. The minimum dimensions of a manhole in which electrical conductors are placed and men

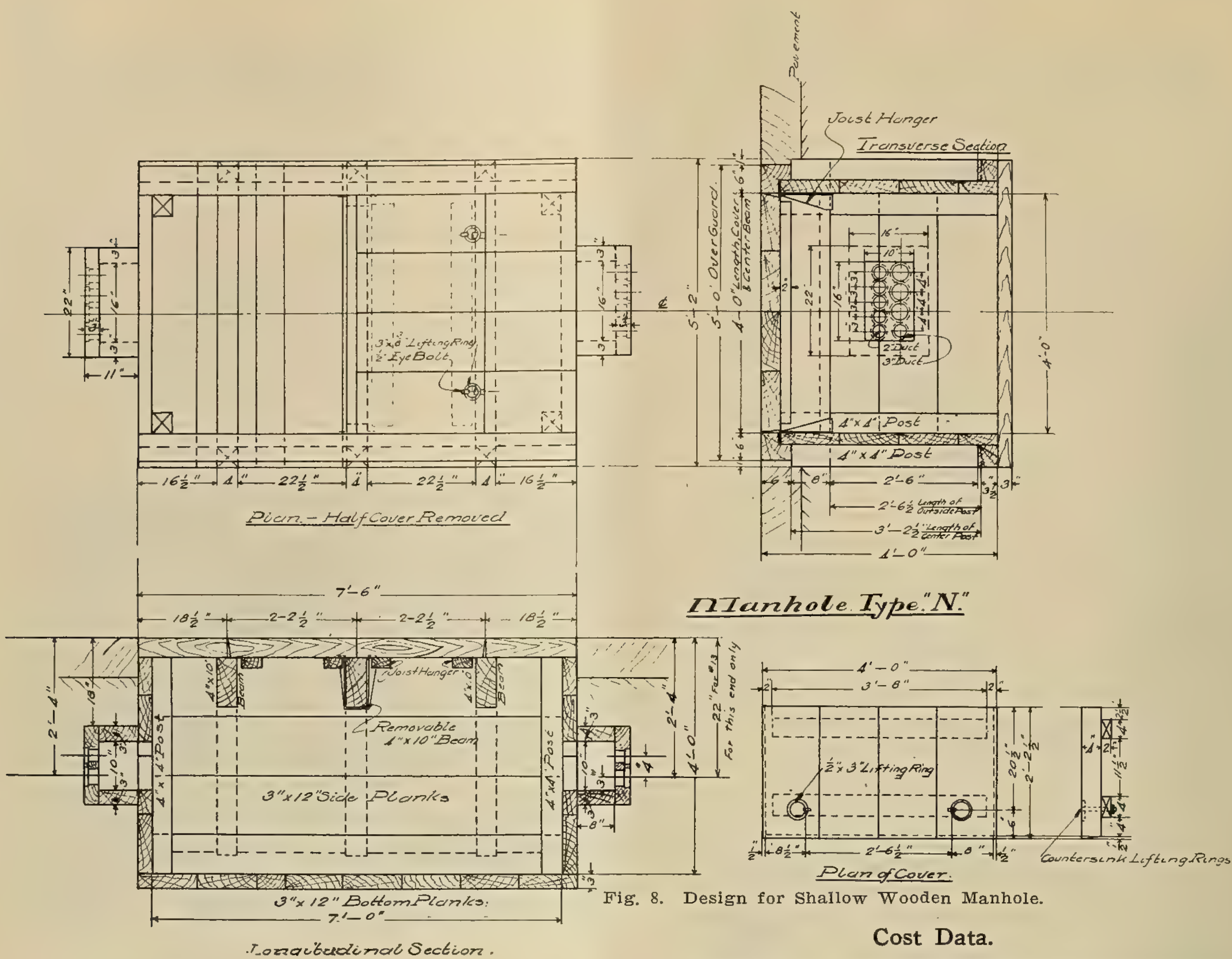
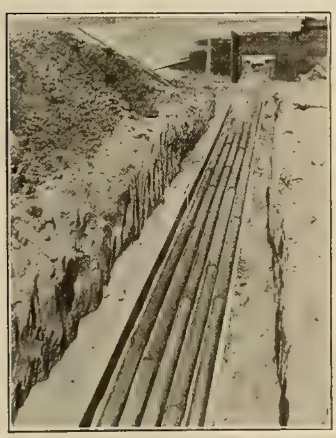


Fig. 8. Design for Shallow Wooden Manhole.



Fibre Duct Conduit Construction.

compelled to work, as set by law, must be 4 x 4 ft. in the clear with 5 ft. clear head room.

These manholes will vary in size from 4 ft. x 4 ft. 6 in. to 6 x 8 ft. and have an entrance 4 ft. square in the clear. The covers will be made in two pieces, supported by a removable center beam. By the removal of this 4 ft. cover these shallow holes will meet the requirements of the law.

Not only will this conduit system provide facilities for primary cable, but also for all arc cable trunks as well as the private telephone and signal system of the exposition.

Cost Data.

Thus far two contracts have been let for the installation of this work, all conduit located in the Exhibit Buildings Section being awarded under one contract, and all conduit in the States and Foreign Sites Section under a separate contract. Actual work is now being carried on in both sections.

The following unit costs are the actual contract prices quoted and accepted:

EXHIBIT BUILDINGS SECTION—CONDUIT.

Installing 3 in. inside diameter wood fibre duct in standard concrete construction; conduit section 12 to 24 ducts, at 11c per duct foot.

Installing 3 in. inside diameter wood fibre duct in adopted wood box construction; conduit section 18 to 21 ducts, at 8.65c per duct foot.

Installing 3 in. inside diameter wood fibre duct in adopted wood box construction; conduit section 10 to 15 ducts, at 9.91c per duct foot.

Installing 3 in. inside diameter wood fibre duct in adopted wood box constructions; conduit section 4 to 8 ducts, at 12.33c per duct foot.

The average cost for installing 3 in. wood fibre duct in wood box construction is 10.3c per duct foot.

EXHIBIT BUILDINGS SECTION—MANHOLES.

Manholes of timber construction ranging in size from 5 x 6 ft. and 5 ft. deep at $36 each, to 7 x 8 ft. and 6 ft. deep at $65 each. Average, $49.30 each in place.

Manholes of concrete construction ranging in size from 7 x 7 ft. and 7 feet deep to 8 x 8 ft. and 7 ft. deep average $129.30 each in place, exclusive of cast iron cover which is furnished by the Exposition Company.

STATES AND FOREIGN SITES SECTION—CONDUIT.

Installing twelve 2 in. and six 3 in. inside diameter wood fibre duct in wood box construction, at $1.47 per conduit foot.

Installing six 2 in. and three 3 in. inside diameter wood fibre duct in wood box construction, at $0.93 per conduit foot.

Installing three 4 in. and three 2 in. inside diameter wood fibre duct in wood box construction, at $0.76½ per conduit foot.

The average cost, in place, for installing 3 in. wood fibre duct ranging in sections as given above, is $0.10.3 per duct foot.

STATES AND FOREIGN SITES SECTION—MANHOLES.

The actual prices of the shallow type of wooden manholes used in this section range from $20 to $27 each, and average $25 each in place.

MULTIPLEX TELEGRAPHY AND TELEPHONY

BY W. R. BIRT.[1]

During these times when so much is being said about economy, efficiency and conservation of various forms of energy, it might not be amiss to consider some of the ways that savings may be effected in the telegraph department of a railroad.

Railroads generally have long lines of copper multiplex telegraph circuits extending from their general offices to their many divisional headquarters. These circuits are used exclusively for the movement of long haul commercial and executive business of the railroad company. The message load they are expected to protect rarely exceeds the capacity of a polar duplex circuit. On a railroad having 6000 miles of operated road, this class of circuits is frequently in excess of 3000 miles. The cost of line construction of such circuits, based on the cost of wire, insulators, pins, tie-wires, sleeves and labor, is $38.79 per mile. Assuming a50-year life, a net scrap value of$21.30 per mile, maintenance $1.00 per mile, taxes at one per cent, interest at 6 per cent, and $2,00 per mile for taking down, would cause an annual charge of $4.06 per mile to be assessed against these circuits. The utilization of this existing plant when equipping divisions with telephonic train dispatching and message circuits will make possible a saving of from $116,000 to $135,000.

The telephone train dispatching circuit as usually constructed is composed of No. 9 B. & S. gauge hard drawn copper wire. The average length of a train dispatching circuit is 130 miles. In the valley and desert districts the separation between telegraph offices is between 12 and 15 miles; while in the mountain districts, the separation is generally between 5 and 6 miles. The requirements, therefore, are that this circuit shall have a transmissional margin sufficient to admit of from 10 to 22 way-stations simultaneously listening in on the line.

The selective calling equipment now generally employed on these circuits is of the electro-mechanical step-by-step type of selective relay, the essential features of which are a combination wheel and a time wheel, suitably governed by magnet, levers and detents. Just as a combination lock will open only to its own setting, so the selector can be operated only by impulses of a predetermined number and sequence. The combination wheel differs in its teeth cutting in every selector on a circuit, and while the calling impulse sent over the wire actuates every selector, yet it will not go to the contact position and operate to call an office unless its individual combination is made. The selector is wound to 4500 ohms and is connected with the proper taper resistance so as to produce equal current in all bridges.

Automatic calling is accomplished by the use of keys in the dispatcher's cabinet, that have a simple train of gears operating a circuit breaker. The calling may also be done by Morse key sending over the line a predetermined number of impulses of current, properly spaced between each group of impulses.

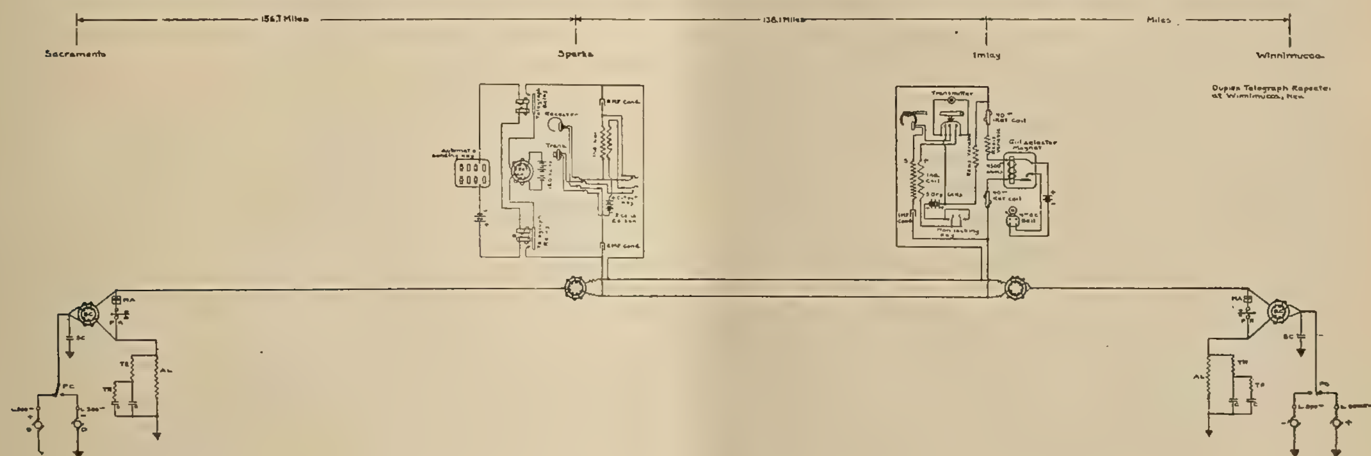


Fig. 1.

The receiver circuit on the best type of railway telephone equipment developed for this class of service has an impedance of 2500 ohms, therefore each receiver that is off of its hook occasions a transmission loss of approximately one cable mile for offices beyond that are receiving from the dispatcher.

In Fig. 1 is shown a typical telephone train dispatching circuit which is in operation over the fourth district of the main line of the Southern Pacific Company's Salt Lake Division, between Sparks, Nevada, and Imlay, Nevada, a distance of 138.1 miles, and over which an Overland multiplex telegraph circuit is being regularly superimposed. The impedance bridges caring for the telegraph circuit at each terminal of the dispatching circuit have an impedance of 29,800 ohms to a frequency of 1000 p.p.s., so therefore occasion a telephonic transmission loss to the dispatching circuit of less than one-tenth of a cable mile each. As the transmission over 30 miles of standard cable is regarded as the commercial limit, it is customary to express the transmission equivalent of any other kind of line as that length which gives the same volume of sound as 30 miles of standard cable. The attenuation of this cable at 800 p.p.s. is 0.103, and that for No. 9 B. & S. gauge hard drawn copper wire is .00652,

[1]Paper presented before San Francisco Section, A. I. E. E., May 23, 1913.

therefore the length to which speech is commercial over this type of circuit becomes

$$L = \frac{0.103 \times 30}{.00652} = 474 \text{ miles.}$$

As this dispatching circuit is but 138.1 miles in length the line transmission loss at 15.8 miles of wire to one mile of cable, is 8.7 miles of cable, and that occasioned by the telegraph impedance bridges is .2 of a cable mile, there remains an equivalent in transmission of 21.1 cable miles for the way station equipment. There are 31 way station telephone instruments on this line, 12 of which are located at telegraph offices, the balance are in booths at the non-telegraph passing tracks, the possibility, therefore, of more than 21 of these way stations having the receiver simultaneously across the line is quite remote.

The first distinct advantage of the telephone, and one that is noticeable as soon as a circuit is placed in service, is the time saved in calling offices for the purpose of putting out orders. An operator having outside duties, such as delivery of freight, baggage or express, etc., has his attention immediately called to the fact that he is wanted by the ringing of the bell, while by telegraph he is called until he happens to come within earshot of the telegraph instrument; in the meantime, even though only five minutes may have elapsed, this may have made the combination the dispatcher had in mind valueless, and the set back this train received may result in its having a number of bad delays before reaching its terminal. In telegraphic train dispatching, the dispatcher copies the order in his book as it is first repeated; while in telephone dispatching, the order is written in his book as it is transmitted to the interested stations, thus making possible its repetition at about the rate of ordinary conversation, or in approximately one-fourth the time required to repeat it by telegraph.

The train movement which is being protected by the telephone dispatching circuit on the fourth district is perhaps the heaviest on the Salt Lake Division. In addition to having all of the overland passenger and freight trains for a distance of 138.1 miles, the Tonopah trains, the Fallon Branch, the Wadsworth branch and the Fernley-Lassen branch trains are all handled over this district for a distance of about forty miles; besides this the double tracking operations on the east end of the district require that innumerable work train movements against opposing trains be arranged for. The chief dispatcher remarked that between October 5th and November 1st the traffic became so great on this district that had it not been for the telephone dispatching circuit the district would have had to have been divided and an additional set of dispatchers put on to properly handle the traffic. The consensus of opinion, however, is that a telephone dispatching circuit increases the efficiency of the train dispatcher about 25 per cent. Although this train dispatching circuit is on a telegraph lead carrying 17 other telegraph circuits, the interruptions have been very few. Since the circuit was placed in service on September 4, 1912, there have been but four instances where the telegraph had to be resorted to to protect the train movement, and then only for a very few hours. Three interruptions were due to other wires breaking and fouling the dispatching pair, and the fourth was caused by a mica burning through and grounding the circuit in the lightning arrester at a non-telgraphic office.

The telegraph circuit over this dispatching circuit is carrying between 350 and 500 messages during the office-hour period daily, and apparently is as capable of speedy operation with semi-automatic transmitting keys as are those circuits containing no artificial inductance. The transmitting key referred to is used perhaps by four-fifths of the operators of this country. It consists of a vibrating rod or pendulum which when moved to one side by the operator makes a dash, and when moved to the other side automatically vibrates—until stopped by the operator—in the act of so doing making any desired number of dots. It is estimated that sixty per cent more movements are required in sending by the ordinary Morse key than by this device.

The repeating of this circuit at Sacramento has not imposed any noticeable burden upon the repeater attendant at that point, for he is still able to handle nearly 300 messages and perform all of the repeater attendance required during his nine hours of service.

The impedance bridges now in use for the telegraph circuit have a d.c. resistance of 1500 ohms, and it is found that this value does not give the dispatcher a "bat" in the ear when selectively calling a station. On a dispatching circuit 150 miles in length, such bridges together with the joint resistance of the paralleled wires make possible a telegraphic conductor having an ohmic resistance of 1,063½ ohms; the operation of two such dispatching circuits in tandem in bridge duplex telegraph service would require a potential of but 156.6 volts to maintain a line current of .050 amperes. With the multiplex sets poled in conjunction this voltage will develop a working current of 100 milliamperes in the main line, which is the amount used in practice. The increased leakage conductance due to the paralleled wires, however, suggests the use of the third potential (240 volts) on such circuits. The voltages that are standard in telegraph work and which are generally obtainable at the division terminals of a railroad are 160, 240 and 350; the last named potential frequently has a value of 320 volts. The coil lag due to the impedance bridges may be compensated for by placing an equivalent inductance in the artificial line of the multiplex apparatus. In the case of but one telephone dispatching circuit in the telegraph circuit it has not been found necessary to so compensate the artificial line of the multiplex equipment.

Telegraph departments have within themselves other opportunities for economic gains, because, fundamentally, two simple telegraph circuits are wasting one telephonic possibility. Therefore, the primary reason for repeating at Sacramento the circuit shown in Fig. 1, was in order that its telephonic possibilities between Sacramento and San Francisco might be taken advantage of. In Fig. 2 it is shown as the companion wire to the San Francisco-Portland multiplex circuit in a composite telephone circuit between the p.b.x's. at Sacramento and San Francisco. To make this talking circuit commercially quiet through the numerous serial telegraph cables in the city of San Francisco, the submarines and undergrounds, core

strands in even conductor cables were assigned for its reception. With a view to silencing the effect of the Morse signals on the telephone receiver, a differentially connected coil is placed in series with each limb of the talking circuit and the telegraph side connected to the ground through a 6 to 10 microfarad condenser. A pair of conductively connected coils with the middle point grounded are bridged across the talking circuit for the purpose of removing the cross-fire between the telegraph circuits and lessening the noise on the talking circuit.

relay closed during the interval of no magnetism due to the current reversals of the distant pole changer, that this coil is particularly beneficial in quadruplex working, because its magnetic discharge is not only utilized to energize the holding coil, but owing to the gradual manner in which the closed core parts with its magnetism, the discharging current is lengthened out, and it is thus possible for it to act upon the neutral relay armature for a period more nearly equal to that represented by the interval of no current at the distant pole changer. Rapidity of action in the pole

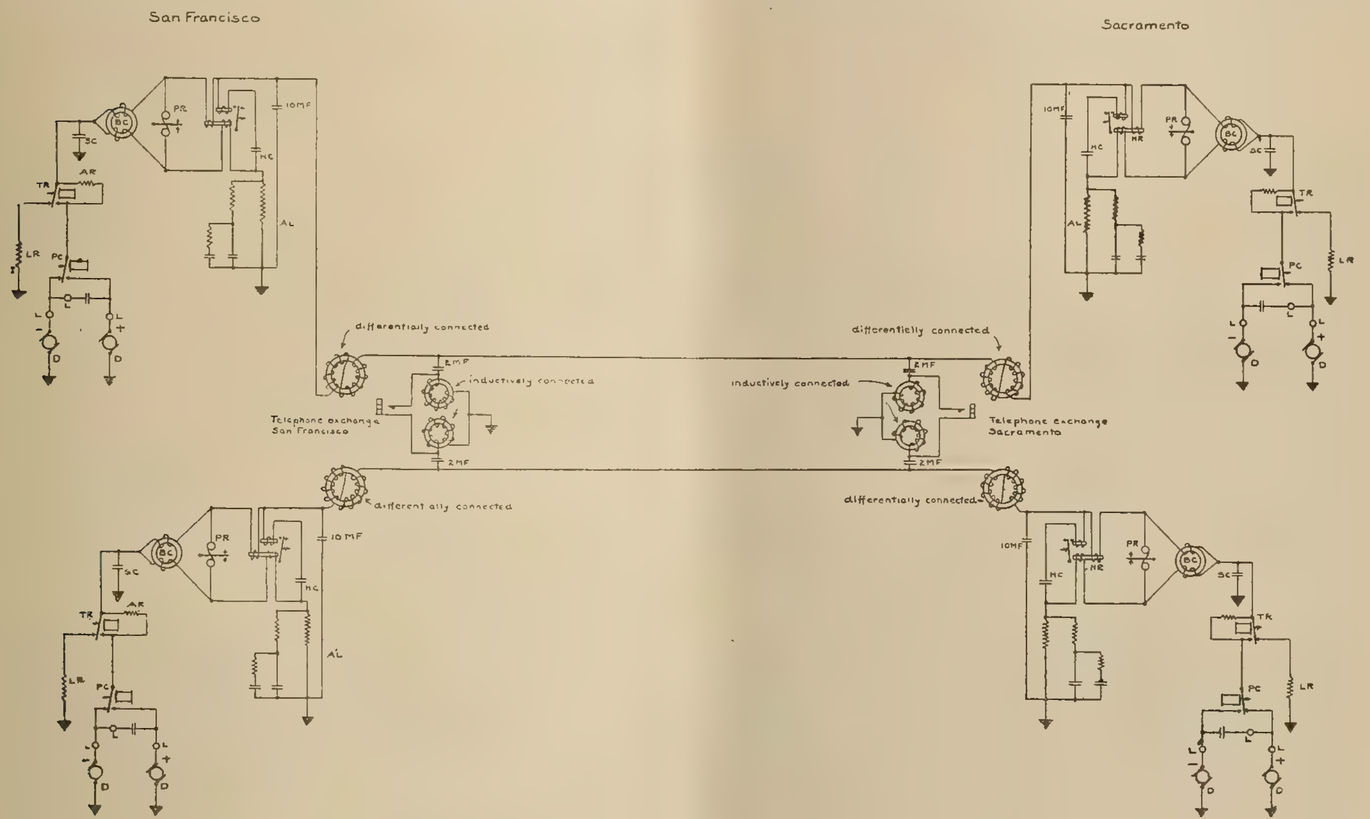


Fig. 2.

The bridge type multiplex apparatus is very efficiently operated over circuits of the composite type; one of the greatest advantages claimed for it being in the arrangement of the bridge coils. Instead of being ordinary non-inductive resistances as in the old type of bridge multiplex apparatus, there are two 500 ohm coils wound upon a ring shaped core of soft iron wires. The theory of which is that because of its closed magnetic circuit, this coil offers great impedance to any current passing through it from one end terminal to the other; consequently, a current coming in over the main line wire at first meets with considerable opposition in its attempt to flow through the bridge coil, and as a result almost all incoming current rushes into the polar relay. This effect lasts only for a small fraction of a second, during which time the opposition to the current in the bridge coil gradually disappears, thus allowing the currents in the various branches to reach their steady values. The brief initial rush of current through the polar relay is sufficient to pull the armature of that instrument over with a speed and precision out of all proportion to the smaller steady current passing through the relay during the remainder of the signal. It is in connection with the operation of the holding coil, which holds the neutral

changer is made possible by its having two electromagnets, one on each side of the armature, and both connected in series in the local circuit. The cores of the front magnet are laminated, which make that magnet quick-acting, while solid cores, surrounded by copper sleeves, are used in the rear magnet to make it slow acting. A light retractile spring is attached to the armature to hold it on the back contact and prevent shivering when the local circuit is open. When the local circuit is closed, current flows through both of the magnets of the pole changer, but the front magnet exerts its attraction slightly in advance of the rear magnet and thus pulls up the armature to the front contact. Soon afterwards, the rear magnet becomes fully energized, but cannot pull back the armature because the latter is now much closer to the front magnet. When the local circuit is open, the magnetism in the front magnet falls away very rapidly, while that in the rear magnet dies away gradually; as a result the front magnet releases the armature while the rear magnet is still capable of pulling it back and the armature is thrown over to its back contact much more swiftly than if the retractile spring alone was depended upon for this action.

The arrangement of the apparatus heretofore used

for repeating from one multiplex set to another was that whereby the receiving relay controlled the sending transmitter through local connections, but the mechanical inertia of these instruments and the increased number of local contact points through which the operation is controlled was not conducive to high efficiency. In the center of Fig. 3 is shown two pair of direct-point duplex repeaters; it will be seen that the arriving signal from the east or south will actuate the right hand polar relay thus placing the armature of that instrument in contact with a 240-volt negative potential, which is given an outlet through the center of the bridge coil to the line west, and in a like manner signals arriving from the west are relayed to the east by a reverse operation. As the local contact points of the polar relays are now employed to deliver line currents, special devices are provided to control the local circuits for operating reading sounders. When the direct-point repeater was first introduced the polar relays were equipped with double armatures, mechanically jointed together, but electrically separated, one contact controlling the line potentials, and the other the local circuit. The later day practice is to use the leak arrangement whereby a single tap is taken off of the armature of each polar relay and led to the ground through an adjustable 15,000 or 20,000 ohm rheostat. Another method of accomplishing the same result is to substitute a 0.5 mf. condenser for the leak coil, thus obtaining the same response in the polar relay without any loss of current through the leak coil to the ground. The facility of operation, therefore, of the present type of multiplex repeaters contributes in no small measure towards removing the limitations formerly placed on the permissable number of multiplex repeaters in a circuit.

Upon the completion of a dispatching circuit over a busy division, there is usually a demand for a like message circuit. When a division has both a dispatching and message circuit in service, it is obvious that the wires may be used not only for local station-to-station dispatching and message purposes, but for two through multiplex telegraph circuits and a phantom talking circuit as well.

Within 60 days, 63 per cent of the main line of the coast division will have been completely equipped for telephone train dispatching service. Upon its final completion, it is expected that the circuits will be arranged as shown in Fig. 3. The phantom talking circuit thus obtained being carried to the telephone exchanges at San Francisco and Los Angeles.

The coast line route is about 473 miles and is an all open wire lead, and as the commercial limit of the physicals upon which the phantom is to be built is 474 miles, it is expected that with the 10 to 14 per cent increased transmission possible with phantom circuits, that the repeating coil losses will be sufficiently overcome so as to make possible acceptable speech transmission between the locals off of the two exchanges.

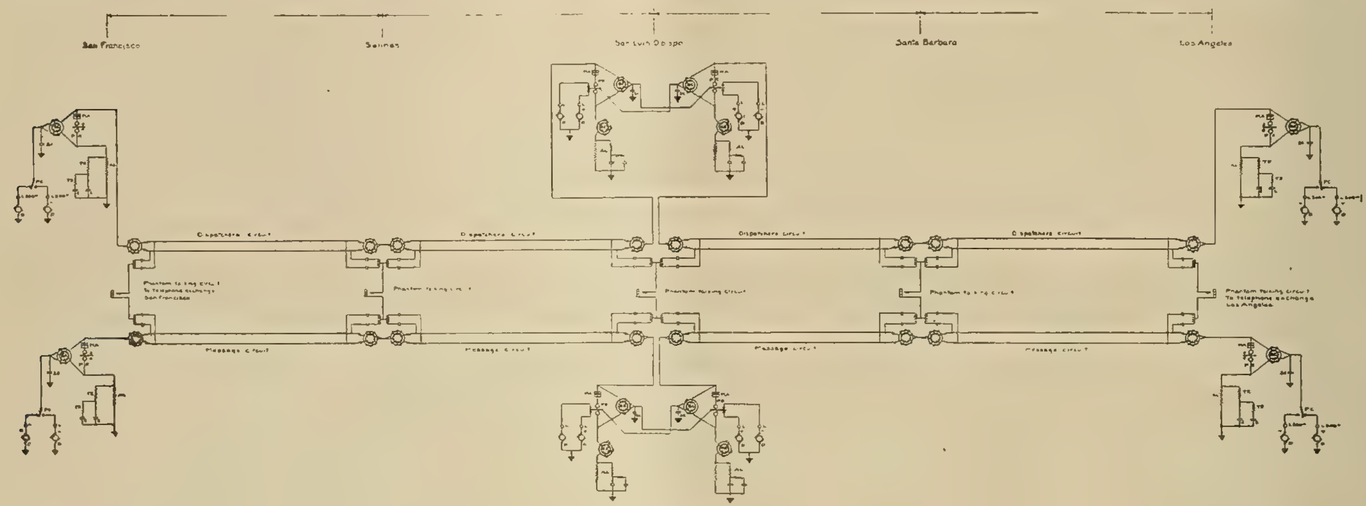


Fig. 3

As the plant economy fully justifies the placing of additional repeaters in long haul message circuits so as to admit of their use in divisional telephone service, the superintendent of telegraph of the Southern Pacific Company is arranging his outside wire plant so as to admit of the use of all existing copper multiplex telegraph circuits in simplex, composite and phantom telephone service as well.

SUCCESSFUL ENGINEERING OPERATION AT LAKE SPAULDING.

Now that snow has receded to the higher reaches in the Sierras, work on the new Lake Spaulding dam is again well under way. This dam which is being built by the Pacific Gas & Electric Company below the outlet of Lake Spaulding to increase the storage capacity of that lake more than 15 times, and which will be the highest dam in the world will form a part of the 165,000 horsepower development for that company which is well under way. The dam will have a gravity section and will be a solid concrete structure which will contain about 300,000 cu. yds. of concrete. Two Portland cement companies in California are working night and day to supply the cement necessary for this work and the amount of rock necessary which is being quarried out of the cliffs immediately above the dam is necessarily enormous.

In order to obtain large plumb stones a tunnel was driven into the cliff above the dam site and this was loaded with two charges of high explosive under the direction of an expert powder operator, the object being to bring down at once enough rock for construc-

tion work. The blast which was let off last week was successful and loosened even more rock than it had been calculated would be dislodged. At the time the South Yuba River was unusually high and the rock piling into the bed of the river caused the water to flow over the top of the concrete work already in place. A derrick was also displaced by the force of the blast.

Reports emanating from some unknown source that an accident had occurred, damaging the dam, were erroneous, as the blast was only a part of this work which is of great magnitude. For a short time the water flow caused the cessation of the work of pouring concrete in the dam, but this was resumed the following day. Work is progressing very rapidly and the company expect that by December, when it will be neecssary to cease work for the winter, that the dam will be practically completed.

THE ECONOMIC STATUS OF THE STREET CAR SYSTEM OF SAN FRANCISCO.

BY F. K. BLUE.

There has been such a discrepancy of opinion in regard to the economic status of the street car system of San Francisco that the following study was made in an endeavor to arrive at an unbiased view of the situation based on a careful examination of the information available.

The data are taken chiefly from the report of Bion J. Arnold, to which references are made. The estimates of population and other items have been compared with other estimates worked out independently and found to be in substantial agreement.

In order to reach a comparative view of values under different circumstances, probable net earnings and the present values of such net earnings have been estimated for various assumed conditions for a period of 40 years as follows:

1. Part of the system covered by the present franchises, operated by the United Railroads with minimum betterments, as at present to yield the greatest return during the life of their franchises.
2. Part of the system covered by the present franchises operated by the United Railroads during their life, with betterments and operative improvements necessary for efficient and satisfactory service.
3. The whole system operated by a single private company with betterments and improvements necessary for efficient and satisfactory service.
4. Part of system not covered by present franchises operated by the City with betterments and improvements necessary for efficient and satisfactory service, and with wage conditions conforming to the provisions of the charter.
5. Whole system operated by the United Railroads according to Arnold's recommendation. "Plan 5," under the proposed Charter Amendment No. 34.
6. Whole system operated by the United Railroads under the self-adjusting rate fixing method.

Operation by the United Railroads for Maximum Profit.

The present value of the investment is assumed to be $28,000,000 and the present depreciated or physical value of the property is assumed at $21,000,000 as indicated in the Report of Bion J. Arnold (p. 86). This corresponds to an investment at the rate of about $110,000 per mile of single track while the present cost of extensions is about $80,000 per mile (see Report, Table 9). Since no fund has been accumulated to keep the value of the tangible assets up to the amount of the investment, the real investment has thereby been reduced to the depreciated value of $21,000,000, the remaining $7,000,000 having been liquidated by being paid to the security holders in the form of interest and dividends; and since that sum is now presumably bearing interest in some other investment, it has no right to be considered as entitled to interest as a part of the tangible assets of the property. The present value of the real cost of the investment will therefore be considered to be $21,000,000.

The additional investment in minimum betterments just sufficient to maintain the operating integrity oi the property is estimated by Arnold to be about $8,000,000 (Report, p. 83.) This sum distributed

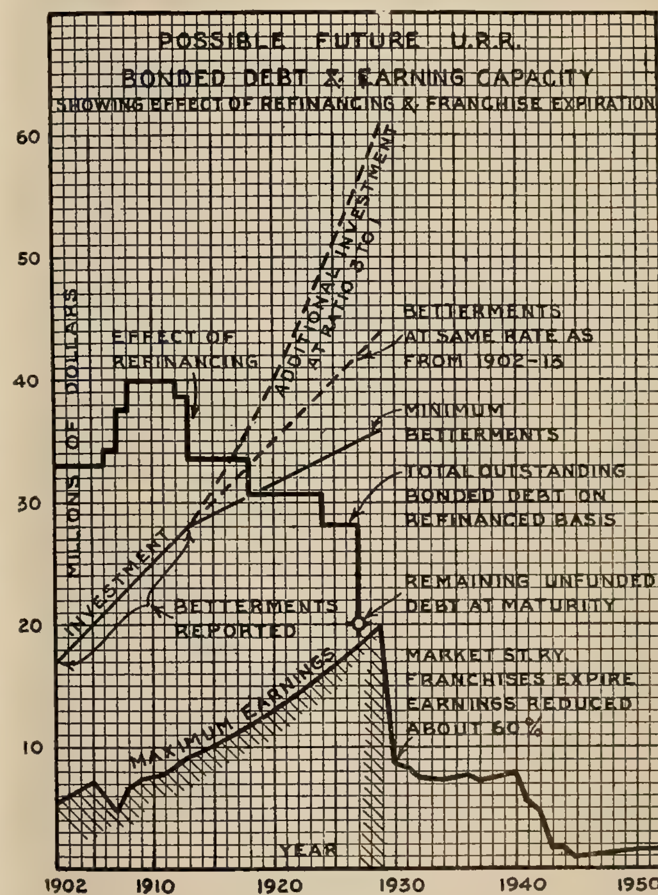


Fig. 1.

over the period as shown in Fig. 1, would be made available by the present investment of $5,060,000 at 6 per cent interest. The present value of the cost of the whole required investment is therefore $26,060,000.

In order to reduce all future incomes and expenditures to a common basis at which they are properly commensurable their present worth has been computed as of 1912 with interest at 6 per cent. This rate of interest has been taken as substantially the public estimate of the value of investment in the property, as shown by the market price of the underlying securities. Therefore the cost of future investments may be measured by the present cost of the bonds that

might be purchased now to meet such future payments, and the value of future income may be measured by the amount that might be realized at present from bonds that would amount in the future to the value of the future income.

The total probable earnings of the company are based on Table 5 of the Report, and Fig. 1, taking into account the relative mileage (p. 400) which would be operated by the United Railroads and by some other corporation or by the City, and having due regard for the relatively greater earnings per mile from the lines already established. The gross earnings of the United Railroads for the year 1929, estimated in this manner, amount to $14,100,000, while the total earnings of the whole system (as shown by Table 5 and Fig. 5) are estimated at $19,900,000. From an independent computation Arnold states that the gross earnings of the United Railroads without extensions for the year 1929 might be $15,000,000 (p. 394). After 1929 the earnings range from $7,000,000 to $1,000,000, on acount of the lapse of franchises.

As shown in Table 41 of the Report, the total operating expenses of the United Railroads, not including depreciation, are now about 60 per cent of the gross earnings, and have been decreasing for the last four years. Assuming that it would continue to take 60 per cent of the gross earnings for the operation of the property and the maintenance of its operating integrity the total net income would then be 40 per cent of the gross earnings, and for the forty year period until the last of the present franchises expires would amount to $110,000,000. At 6 per cent interest the present worth is these items of income is $53,990,000.

It is assumed that the remaining physical value of the $36,000,000 investment is liquidated from time to time during the period from 1929 to 1952 as the present franchises expire. Since no allowance has been made in this estimate for keeping the property up to a proper operating condition, it is assumed that one-fourth of its cost or $9,000,000 might be realized from it as the franchises expire. The present worth of these sums amounts to $2,350,000. The present value of all the resources of the property then amounts to $53,990,000 plus $2,350,000, which equals $56,340,000. Subtracting from this, $26,060,000, the present value of the investment required, leaves $30,280,000, which is the present value of the franchises under these conditions, and represents literally an absolutely free gift that was made by the people of San Francisco to the street car companies by the granting of the franchises, providing the board of supervisors do not or cannot secure more reasonable service or a lower fare from the United Railroads.

(To be continued.)

PROGRESS ON PANAMA CANAL.

According to present plans, Gatun Lake, now practically stationary at about 49 ft., will be allowed to fill after July 1, until it has reached its normal level of 85 ft., which event, in case there is a season of average rainfall, is expected to take place about December 1. The rise in the lake level will probably flood Culebra Cut shortly after October 1, causing a suspension of steamshovel operations near that date.

ABSTRACTS OF PAPERS PRESENTED AT THE THIRTY-SIXTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION AT CHICAGO, JUNE 2-6, 1913.

The following abstracts and titles of papers presented this week at the Thirty-sixth Convention of the National Electric Light Association show in a general way what is being done at the convention:

Electric Railway Loads on Central Stations.

Attention is called to the desirability of railway loads, both city and interurban, as power customers for central stations. In some of the larger cities the problem has been very thoroughly worked out and excellent results obtained by combining the requirements of the two classes of service on one generating system. There still remain, however, many opportunities for improvement in this direction, and the problem, if carefully studied, will probably disclose possibilities not heretofore considered. The growing tendency to combine various communities over large areas under one generating system will naturally tend to increase the number of cases where central stations carry the railway load. Recent improvements in transforming apparatus—notably 60-cycle rotary converters—are strong factors in the development of this business, since practically all lighting companies which have a purely light and power load are now operating on the 60-cycle basis. Typical load curves are shown indicating an improvement in load-factor as the result of combining railway load with light and power load, and also demonstrating that the central station is not burdened with an extraordinary peak as a result of the railway load. The diversity factor between railway loads and central station loads when combined on one generating system is an important consideration, since the combined loads can be carried on a generating station of much smaller total capacity than if they were separate and carried on individual stations. Furthermore, the necessary reserve capacity in the case of the combined station is also less.

Factors Producing Reliability in the Suspension Insulator.

Transmission line insulators are affected little, if any, by normal working loads, providing high maximum stresses are not set up. As the reliability of an insulator depends largely on the factor of safety, provided not for apparent loads but for the maximum stresses set up in the dielectric, it is important that true factors of safety be determined.

Two strain or dead end insulators having the same ultimate mechanical strength may have far different internal stresses for the same load. Combined stresses due to temperature and load may reach a very high value for a comparatively low working load. Since strain insulators work under comparatively low factors of safety, damage due to static puncture or partial mechanical failure will tend to show up, particularly on hot days. In some systems the lowered factors of safety on dead end insulators decreases the reliability so that a single insulator of this type may constitute a greater hazard than miles of purely suspension line. This makes their use for increased safety often questionable.

Electrical factors of safety may be increased for the unit by testing above flashing voltage. This can be done by the surge test or by oscillations set up when insulators spill with poor regulation in the testing apparatus. The use of protecting air path is the only efficient means of protecting insulators for severe surges, the reliability of the insulator increasing as the ratio dielectric strength to protecting air path increases. This protection is increased by short spacing, good distribution of stresses in series and decreased time lag in the protecting gap. The tendency is to increase the factors of safety which is most easily done with small efficient members.

Owing to the effect of mechanical strength on the design, further increase in the factors of safety must be accomplished by discharge horns, or by decreasing the protecting gap. Since the factors of safety are low at best, great care should be taken in deciding on the mechanics of the line, so as to keep down maximum stresses in order that the factors of safety may be large enough to give the desired reliability.

Transformers for Power Transmission.

The great tendency at the present time toward centralization of power is making many interesting problems on power distribution. The voltage chosen for distribution must be high enough for economical transmission and not so high that the cost of a complete substation installation makes it impractical to install those of small and moderate capacity.

The development of the outdoor transformer with the necessary switching and protective devices has made it possible to use installations of small capacity at a high voltage and at very moderate cost.

In the paper is given a curve of costs for installations of different capacity for various voltages. It shows that where the transmission lines feed a number of small commuunities, the economical voltage is 22,000 or 33,000.

It is shown that the saving by the use of an extremely small size transformer is so slight in comparison with the total cost of installation as to be negligible.

It is pointed out that there is a wide variance in characteristics demanded by the different power stations, more particularly as regards voltage variation and taps. Special emphasis is laid on the great extensions that are being made in the use of all transformers and the need of standardization as regards taps. Such standardization will result in much good to the industry at large, to the manufacturer and the customer.

Transmission Line Construction.

While the scope of this paper is not limited to any particular voltages, the matter discussed relates primarily to transmission lines carrying voltages above the 2300-volt class, and it is hoped that the outline of the author's views may result in a discussion by the meeting that will be of benefit in a discussion of the art.

In general, the construction or structural features are considered rather than the electrical or operating conditions.

It is apparent that the author considers the physical characteristics of a pole or tower line as deserving of careful attention, and that a too hasty inclusion of mechanical limitations in a specification may result either in a disproportionate expense to the industry or in transmission lines of inadequate strength.

Switchboard Instruments.

Both alternating - current and direct - current switchboard indicating meters for central-station service are described as well as new forms of alternating-current protective relays. The general features of interest common to all switchboard indicating instruments are accuracy, compactness, reliability, damping, ruggedness, accessibility and simplicity.

The sources of error or unreliability may be classified as electrical, mechanical and observational. As the electrical sources of error on the best makes of instruments are now nearly all negligible for operating purposes, the mechanical sources of erro. are of greatest importance, the principal sources being: (1) excessive weight of movement, (2) insufficient ruggedness of movement, and (3) insufficient controlling force.

Previous attempts to economize switchboard space by reducing the meter diameter were unsatisfactory because they resulted in scales of insufficient length, and other methods of economizing space by recourse to curved dials, as in edgewise meters, were likewise unsatisfactory.

The induction principle makes possible the successful-seven-inch meter, as the scale is two or three times as long as in the nine-inch meter. As the large instruments offer no advantages over these seven-inch types the latter will probably be used to greater extent in the future.

The effect of stray fields from bus-bars upon the permanency of the magnets in direct current D'Arsonval type of meters is discussed, and tests show that magnetic shielding is of no value in avoiding demagnetization when heavy short-circuits occur. A type of construction is shown in which the magnets are located so as to be practically unaffected by the stray fields.

Four different variations of a new line of alternating current induction type relays are described, giving protection against overloads and reverse currents. These relays depend for their inverse time action upon the damping effect of permanent magnets acting upon the movement disk. The overload relays can be adjusted for inverse time curves which either become instantaneous, or definite at very high overloads, thus affording means of obtaining selective protection on feeders or the lines operated in series or in parallel.

Relays located at substation terminals of transmission lines should be arranged so that tripping can never take place because of power flowing into the substation. Relays "D" completely solve the problems of reverse current protection, even in cases where voltage and power factor drop to low value during short circuits. These relays also furnish protection to ring systems of feeders, entirely clearing the line in case of ground or a short between stations.

Developments in Protective Apparatus.

Improvements in oil and carbon circuit breakers and lightning arresters due to the high voltages and

generating capacities now in general use are described in a large number of types and sizes to meet various requirements at voltages up to 165,000 and conducting capacities up to 2400 amperes.

Design and constructional improvements of oil circuit breakers include porcelain insulating pillars, clamped in position, contact details clamped thereto, use of removable separate arcing contacts, heavy steel plate tanks with lap welded points, greater volume and head of oil, and strong tank supporting details. Expansion chambers and appropriate vents are provided for the arc gases in all designs.

The floor mounting form of breaker without enclosing structure is quite popular, especially in high voltage service.

For very high capacity and voltage a breaker having self-contained reactance cut into circuit on operation of the breaker is now standard.

Carbon breakers are now made in standard capacities from 3 amperes to 24,000 amperes up to 1500 volts direct current. Modern types include the "butt" wiping form of laminated brush with metal secondary contacts and "butt" and wiping carbon final contacts. A new feature in a line of breakers for moderate conducting and breaking capacity is the use of pressed metal parts nearly throughout.

The heavy service breakers, for the higher currents and voltages have several steps of increasing resistance in shunt to the main contacts, are provided with ventilating passages between the several brush units, which also reduces the skin effect on alternating current, and use the laminated or "bus bar" form of terminal stud.

The aluminum electrolytic arrester has displaced all others for severe service. They are very rugged in design and light pipe-frame supports are used for the auxiliaries and insulating linings in the tanks. Daily charging is the usual practice and the so-called "charging resistance" is used quite generally where the surges due to charging might cause trouble. An inorganic electrolyte and the annular form of tray have demonstrated their effectiveness.

Report of the Committee on Distributing Lines.

In the discussion of distributing lines voltage is not considered as a limiting feature.

The construction especially considered is that of the Western and Pacific Coast States, since these have done most of the pioneer work in distribution. Many changes have been made in methods of transmitting and distributing electrical energy. Voltages which a short time ago were not considered commercial possibilities are today being used not only on long transmission lines but very generally for distributing purposes.

Rates are continually being reduced as the territory served increases, thus forcing operating companies to adopt a construction the cost of which will be the minimum consistent with good service.

A study of the voltages to be adopted in new territory is made and a comparison drawn between these and the demands of congested business centers. Star and delta connections, alternating and direct current, the use of batteries and of the turbine for both reserve and regulating purposes, all have attention in connection with the problem as a whole.

Types of line construction have not changed greatly during the past few years. A satisfactory way of carrying two circuits on the same line of poles is given. The use of iron wire is suggested where load is small and voltage regulation not of great importance, as in reclamation and irrigation work.

The rather severe requirements of the California Commission with regard to crossing construction are discussed. The relation of gross revenue to cost of investments in new line extensions is studied in its connection with long time contracts with customers. Sometimes the extension might be made on the basis of gross revenue for five or an even greater number of years equalling the investment. The percentage of power bills rebated averages from 20 to 25.

Report of Committee on Prime Movers.

Water Power.—Recent improvements in thrust bearing and runner design have eliminated certain objections to the vertical unit. The following subjects have received further consideration: Runner Wear and Material, Testing of Water Wheels and Forms of Stop and Relief Valves. Mention is made of two notable recent installations. The appendix contains detailed information on the principal points investigated.

Steam Power.—Developments in the Steam Turbine during the past year have been treated at some length, as well as the development in Steam Turbine-Driven Auxiliaries. The subject of Fuel Oil is treated quite completely. Various kinds of apparatus for determining the efficiency of the Steam Plant are discussed in considerable detail and special attention has been given to the Boiler House equipment.

Gas Power.—A very complete resume of the general Petroleum situation is given in the report, as well as the fluctuations in the cost of this fuel. The development of Heavy Oil Engines is treated at some length and specifications are given for suitable oil for these engines. The developments of the Humphrey Gas-Power Pump are reported upon and mention is made of the progress in development of the Gas Turbine.

A partial digest of the recent engineering publications bearing on the subject of Prime Movers and accessory apparatus, is included at the end of the report.

Report of the Committee on Measurements.

Reference is made to recent actions of various engineering societies and committees recommending the abandonment of the "horsepower" as a unit in engineering, and the substitution of the "watt" or some of its recognized decimal multiples—the "hectowatt," "kilowatt" and "myriawatt." Machines transforming power from one type to another, such as hydroelectric units or turbo-generator units, are more rationally and simply estimated as to efficiency, by rating both their input and output in the same unit. Since it is not desired by any engineers to use either "British thermal units," "boiler horsepower," or "mechanical horsepower" for their powers at both the throttle and the generator terminals of, say, turbo-generators, it is natural and desirable to express both input and output in watts.

Reference is also made to proposed recognition of the name "kelvin" in connection with a C. G. S. unit in the electrostatic system, Lord Kelvin having greatly developed both electrostatic measurements and the C. G. S. system.

The Latest Developments in Distributing Transformers.

The most important recent improvements in distributing transformers have been in relation to the materials and methods of winding and insulating the coils. This has resulted in higher factors of safety between the actual disruptive strength of the insulation and the commercial tests applied. In some cases the commercial disruptive tests have actually been increased over those formerly used, due to the greater insulation strength secured, and the qualities of ruggedness, durability and safety in operation have been correspondingly enhanced. A further result of these improvements has been to increase the operating efficiency of the transformer.

The first part of this paper discusses these superior insulating materials and the scientific method used in their application as applied particularly to the standard line of 2200-volt distributing transformers. The second part of the paper relates to the improvement in performance which these materials and processes have made possible.

The insulation of a transformer consists of three main parts: (1) between turns and layers of the winding, (2) between the high and low tension windings, (3) between the windings and the metallic parts of the transformer.

Since the insulation of a transformer is no stronger than its weakest part, its various elements must be considered in their relation to each other.

The improvements in winding and insulating discussed in the paper, in the main result from the guttered winding going with the machine type of coil, the use of improved machine formed insulating barriers and the arrangement of the oil circulating ducts. This has given lower iron and copper losses and at the same time the insulation has been improved. The improved insulation, aside from making lower iron and copper losses possible, has permitted an increase in the values of the commercial tests used.

Report of the Committee on Underground Construction

The report of the Committee on Underground Construction deals this year exclusively with high-tension transmission cables, and discusses periodic testing, the carrying capacity, graded insulation, sector conductors, current-limiting reactances, protection of cables in manholes, parallel routes, trouble reports, practical hints as to operation and specifications for paper and rubber-insulated cables for underground operating pressures in excess of 2000 volts. Considerable space is given to carrying capacity, and recommendation is made of a very decided increase in rating during the winter; also that the current rating be varied inversely with the voltage, on account of the heating in the insulation due to the leakage of current. Interest will probably be sharply aroused by the intimation that in paper cable American manufacturers are in some respects behind European, as evidenced, for example, by the bending test. In European cables the bending test is applied three times. American manufacturers consider as too severe, a test of bending, first in one direction and then in the other, twice repeated, to a radius of six times the cable diameter. The specification presented in the report increases the radius of bending to 7½ times the cable diameter. The committee hopes that the discussion of cable carrying capacity at the convention will clear up some important but obscure points.

Report of the Committee on Grounding Secondaries.

After six years of constant agitation, the committee has finally secured unanimous opinion as to the desirability of grounding secondary circuits. It has succeeded in having the National Electrical Code revised and a rule bearing upon this subject now requires the grounding of secondary circuits up to 150 volts and leaves the grounding optional above that voltage.

The committee suggests that all member companies anticipate the enforcement of this rule so far as possible, and calls attention to the importance of making permanent and efficient grounds. The committee recommends as the best ground a solid connection to underground metallic piping systems, making these connections at each service entrance or at other places where the piping can be reached and the connections periodically inspected.

Report of the Committee on Electrical Apparatus.

Turbo-Generators—Manufacturers now indicate their ability to construct high-voltage generators of large capacities without employing auto-transformers; 25,000-kw. generators are now standardized by American manufacturers.

Reactances—A table of important installations of current limiting reactances is submitted, and a discussion on desirable amounts of reactance in various situations is included.

Speed of Rotative Apparatus—Examples are given of recent apparatus constructed to operate at high speeds.

Direct-Coupled Exciters—Two methods of applying direct-coupled exciters to generating units are given.

Rotary Converters—Reference is made to increase in capacity of individual units of all classes of converters, and the material improvements in 60-cycle rotary converters.

Motor Converters—Attention is directed to the commercial application of a comparatively new form of converting apparatus.

Transformer Connections—Cross-reference is made to Report of Transmission Committee on desirable methods of connecting transforming apparatus for all purposes.

Synchronous Condensers—Standard applications of condensers for line regulation and power-factor correction are recited.

Insulation and Rheostats—Improvements in the construction of these two features of electrical apparatus are discussed.

Brushes—Authoritative data regarding the use, care and life of various types of brushes are given.

Outdoor Substations—The advantages and disadvantages of such construction are shown.

Oil-Switches—A new type of oil-switch is described and reference made to improvements in existing types.

Feeder Regulators—Increase in efficiency appears to be the principal advance in this apparatus. A modification of the induction regulator is now available for outdoor service.

Relays—A new form of reverse-current relay is described.

Rectifiers—Improved life of rectifier tubes is noted and a new development of one manufacturer's apparatus is described.

Electrolytic Lightning Arresters—Changes in design and improvements in operation are recited.

High-Potential Testing Apparatus—A technical discussion of the merits of the several arrangements for testing apparatus for use in central station systems is submitted.

Latest Developments in the Flame Carbon Arc Lamp.

This paper deals with some considerations in the design of flame carbon arc lamps from the point of view of the operating and central station man. Attention is mainly directed to features of mechanical and electrical designs.

The mechanical considerations are divided into a summary of points in the stationary parts of the mechanism under the heading of "Statics," while the considerations fundamental in the design of the moving parts of the mechanism are considered under the heading of "Dynamics."

A brief consideration is given to the design of lamp parts and cases to secure the minimum amount of deterioration at a minimum cost. Some attention is also given to indicating how friction may be very largely eliminated in the regulation of a flame carbon arc lamp, and the maintenance and attention kept at a minimum.

Under the heading of "Electrical Design" some of the requirements for good operation are noted and an explanation given of the manner in which these requirements may be met.

The paper is illustrated by views and sketches of various lamp mechanisms and a number of curves analyzing arc lamp performance.

Report of the Lamp Committee.

The work of the committee has been confined largely to publishing in the Association Bulletin articles on the incandescent lamp situation. The committee has felt that this method of furnishing information month by month is of value to the member companies. A list of the articles is given and they are reproduced in full as an appendix.

Under "Lamp Sales" is shown the total output of incandescent lamps for domestic use, indicating the increase in percentage each year since 1907. The total sales for 1912 increased 6 per cent over 1911, the gem and mazda types representing about 75 per cent of the total. The sale of the carbon lamp is rapidly decreasing, being less than 50 per cent of the preceding year, and conditions indicate the rapid substitution of the metallized and mazda lamps for the carbon.

By reference to the table and curve forming a part of the report the general trend in this direction, as well as other detail, will be apparent.

Under "Development" the report undertakes to show the progress made by manufacturers throughout the year, this has been very rapid, improving as they have the quality of the tungsten filament lamps. These improvements are set forth in some detail. As to prices, the tendency is continually downward.

The development throughout the country in the electric sign business has been very marked, as set forth.

The new types of lamps standardized throughout are listed in detail.

The trade name "mazda" has now been adopted generally by American manufacturers for the tungsten filament lamp. The popularity of the lamp under this trade mark is being rapidly furthered through a liberal policy in its introduction on the part of central station companies and wide publicity given by the manufacturers.

Certain suggestions and recommendations are included within the report.

Report of the Committee on Advertising.

Definite and specific recommendations are given to member companies in towns of less than 100,000 population, on why, when, where and how they should advertise. The paper has been compiled after making careful and personal investigations among the smaller central stations in all parts of the country. It maintains only such advertising campaigns as have proved successful, taking up in succession the selection of an advertising man; the making of the advertising appropriation; the mediums of advertising, under which are discussed the relative values of different newspapers for the advertising of different articles and services; the use of electric signs; the use of the mails, window displays, shows, demonstrations and fairs; theater program and scheme advertising; billboards and moving-picture screens.

The report also discusses in detail "copy" to be used for seasonable advertising, and gives outlines of several campaigns, including a house-wiring campaign, the preparation of mailing lists, etc. It further includes a discussion of co-operative electrical advertising, house organs, and the value of Commercial Section literature to the individual advertising of any member company. The paper is a recommendation for the consideration of advertising and selling as seriously as engineering and operation, in the belief that they are quite as important to the profitable operation of a central station.

Report of Committee on Steam Heating.

1. General discussion of the elements which affect the profitableness of central steam-heating plants.

2. Data on the amount of steam required for restaurants and technical purposes.

3. How to popularize the steam-heating business.

4. Hot water versus steam for heating.

5. Additional suggestions on rates for steam service.

6. Discussion of the availability of exhaust from oil and gas engines for heating buildings. The amount

of heat to be secured about 5 per cent of that from the ordinary simple engine.

7. Study of 12 typical curves, showing the relation between the heating load and the electrical load in ordinary commercial buildings. The utilization of exhaust for heating constitutes a small economy, as compared with the total cost of operating the plant. Small economy secured by using exhaust steam for heating can often be disregarded in order to secure greater economy by the use of large condensing power stations supplemented by independent steam-heating plants for heating limited sections of the commercial district.

Report of the Committee on Electrical Merchandising

This report presents a policy and some methods which, it is believed, may be advantageously utilized in the merchandising of electrical appliances.

It emphasizes the importance of placing this branch of our business on a merchandising basis and strongly advises that appliances be sold at prices which will produce a profit over all costs. It indicates items which should be included in the cost of doing an appliance business and reports the percentage of overhead charges found in the merchandising of appliances by department stores, contractors, supply houses and central stations.

It makes definite recommendations concerning the sale of appliances on installments and the issuing of appliances on trial. It describes some of the successful plans in use by central stations for increasing the sale of appliances.

It touches lightly on the subjects of appliance advertising, repairs and delivery.

A section of the report is devoted to appliance accounting, in which is recommended a simple system of appliance accounting and auditing.

Report of the Committee on Electricity on the Farm.

Practically nothing has been accomplished in real extension of electric lines to the rural districts, largely because of the low density of business to be secured. and because of a lack of faith due to extravagant trade literature, combined with the characteristically small dimensions of the eastern farm. The committee believes that the intensive nature of agriculture necessary in the East, combined with the possibilities of expensive but sufficiently good distribution systems, makes possible a very attractive seasonally off-peak business, especially for the smaller companies where the peripheral zone is large in proportion to that of the metropolitan organizations.

Individual farm applications must of necessity be expensive and rugged, and machines capable of adaptation to a diversity of uses must be kept down to first cost.

Technical efficiency of farm installations must be secondary to convenience, ruggedness, and low cost. Equitable preferential power rates are important, but are secondary to installation expense.

The problem for each individual central station company is unique, must be solved by the company itself, and will require initial expense without immediate return, as did the development of the motor vehicle and industrial power business in the cities. The committee recommends a special man to study and prosecute the farm problem, and believes that half-hearted effort will be money thrown away, while vigorous effort combined with a proper advertising program will produce large results.

Mechanical Office Appliances, Their Uses and Economies.

The paper relates to the operation and uses of many kinds of mechanical devices for office use. The modes of operation and the special advantages of different types of machines and their adaptability to various classes of work are discussed. Economies effected as shown by actual continuous use or by special tests are well brought out. The historical sketch of the principal devices and the relation of one type to another are of great interest and make good reading.

Accounting School and Education of Employes.

Accounting work in the electric lighting industry is increasing in importance, the tendency towards state regulating commissions contributing largely thereto. The rapid growth of the industry into large organizations makes it difficult to depend on experience for a satisfactory accounting education, as the work of each individual is necessarily limited in scope. The public schools do not furnish graduates with satisfactory qualifications and a college training is beyond the reach of most. A course of evening instruction in general accounting, with written examinations to direct serious attention and show results, supplemented by lectures on departmental work and the object and value of accounting to a company was provided by the New York Edison Company. It was demonstrated that such a course was needed and it has also served to direct the attention of the students to the educational possibilities in accounting, to useful text-books and proper courses of study.

Method of Keeping Prepaid and Accrued Accounts.

Many changes have been made in the methods of accounting in central station companies. The keeping of Prepaid and Accrued accounts accurately and conscientiously enables an Auditor to say that the monthly balance sheet reveals actual conditions. Examples of how financial management is aided by the accruing of liabilities. The separation and clear establishment of Prepaid and Accrued accounts relating particularly to taxes is shown. Samples are given of cards for taxing data and special journal forms for taxes. An explanation of forms and examples is worked out to show the method of arriving at the various fiscal year dates and the Prepaid and Accrued amounts. Posting to ledgers is done directly from the combination schedule and journal.

Prepaid insurance premiums should be spread over the period from commencement to expiration of the risk. A check is made on the amounts and dates of bills shown on the Insurance Report, also on the classification of bills. A plan is suggested for divisional accounting, where separate profit and loss statements for subsidiary corporations are desired. Forms are shown that can be used for insurance, bond interest, rentals and income on investments and the suggestion made that an index to the various journals can be used to good advantage in posting.

JOURNAL OF ELECTRICITY
POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electricity and The Law

The electric companies have been harnessed by the law as they in turn have harnessed electricity. The law as a harness has been oddly constructed. The collar has been unevenly padded so that parts of the shoulder have borne most of the burden and become sore; important buckles have been left out and all straps have not been sewed together. The horse has at times become restless, sometimes due to intolerance of restraint and sometimes to the misfit of the harness. Years ago this illustration was used by a noted writer on railroad legislation. Today it is equally applicable to other public service corporations. Our laws are full of inconsistencies and anomalies, spasmodic expressions of legislative impulses and futile attempts of administrative bungles.

The Power of Public Opinion

This journal has published many articles upon power; the power of electricity, of steam, of water, of gas and of air, but their effectiveness pales into insignificance if the development is not endorsed by the power of public opinion. Throughout the course of all history the real "power behind the throne" has been public opinion. Every government that has run counter to its trend has been overthrown, but the leader who trains his aeroplane to its dictates is carried to the highest pinnacles of success.

One ampere of electric current is of little avail without the volt that gives to it the power of the watt. One molecule of gas is inert until dissociated by the electric spark. One cubic foot of steam without pressure can do little work. A single drop of water on the ground is a weak thing, yet united with multitudes of its kind, and given the advantage of a difference in elevation it can sweep aside everything in its path. Thus it is with public opinion—given motion and number it is irresistible. These qualities are imparted by the gradual realization of wrongs, and are liberated by sudden sense of indignity. The machinations of lawyers and politicians can no more stem the flood than can the utmost contrivance of the engineer stop the force of a broken dam.

All power without proper guidance vents itself in destruction. If led through proper channels it is capable of beneficial utilization. Public opinion is guided largely by the great minds in its midst who sway it as they will, until some stronger, and perhaps better, influence attracts it to a new path. For the opinions of even the best of men may be wrong and require but the pointing of the right to be changed.

Today certain strangers who do not appreciate the needs of the West are fostering a sentiment of forest and water hoarding under mistaken ideas that they are thus conserving natural resources. In judicious moderation conservation is greatly needed, but when it will retard the industrial development of the country, leave undeveloped its latent resources, the people dwelling in those communities should suggest that their law makers conserve conservatively. It may take time for this sentiment to grow, but the power of public opinion will finally make itself felt.

The Mathematics of Valuation

In this day of commission regulation of public service companies the business of evaluating properties is becoming one of the duties which the consulting engineer is most frequently called upon to supervise. The details are purely routine, a summation of unit values which can be performed by assistants, a process of integration. But in the determination of the differentials, the elements of value, great skill is necessary.

Appraisers seldom agree as to the value of a public service plant. This is not because of individual bias, but is due to the lack of a uniform basis of valuation. Recently it has become customary to calculate rates for public utilities and to levy taxes on the companies furnishing them upon the estimated worth of the property. This estimate is often made by an arbiter, an engineer whose wide experience in designing, installing and operating such plants has qualified him to act in this capacity. It if were possible to assemble and co-ordinate the experience of a number of such arbiters, we would have the foundation upon which to build a new science, that of appraising.

Analysis shows that the value of any business is dual—the corporeal and the incorporeal. In bookkeeping, these are written as "furniture and fixtures" and "good will." In a public utility plant they are represented by the physical value and the franchise and going values. The first is tangible and readily calculated from the cost of replacing a similar plant, less the depreciation. The last two, being intangible, have been the bone of bitter contention.

It is frequently argued that a franchise, being a license gratuitously granted by the people, should not be capitalized by a corporation because the increased cost of service compels the people to pay the fixed charges on what was formerly their own property. But as the corporation pays taxes on its franchise, it feels justified in calling it an asset. The investment is made "not in the franchise, but under the franchise, and in the faith thereof." The courts have repeatedly recognized the franchise as property whose value depends upon its earning power. An average of many franchise valuations has been estimated by Henry Floy to be about one-third of the actual replacement value of the corporation's assets.

Finally, there is the going value, which is represented by an established or operating business, as distinguished from one that is merely ready for business. Commission rulings are almost unanimous in recommending this element of the problem and its correct determination is of the most vital import.

In the past the tendency has been toward an arbitrary and artificial standard for these several factors. Such empirical rules are typical of all incomplete sciences. The slightest error in a primary determination throws out all later computations and invalidates the final summation. A most excellent remedy has been recently suggested by Mr. H. F. Stimpson in the Bulletin of the Efficiency Society.

Energy is a property common to all service and commodities supplied by public utility companies. By the application of energy to material the latter is transported and transformed in such a manner as to be fit for the use of man, when it becomes a commodity. As all types of energy spring from a common origin, the sun, it may not be unreasonable to infer that their several differences are merely those of volume and intensity. Mr. Stimpson further suggests that the discovery of such a common denominator, together with the duty of certifying to the resultant measurements should be entrusted to a Federal commission, just as the duty of coining money is so entrusted.

Newspaper Jargon

Electricity is now so widely used that its technical terms, hitherto sacred to the scientist, are becoming an integral part of our common speech, especially through the medium of the daily press. Unfortunately, the average newspaper man knows but little about the electric power that takes him to his work, brings him his news, lights his office, operates his linotype and prints his paper. The vagueness of his writings reflects and transmits his ignorance to his readers, who thus unconsciously acquire much misinformation.

How often do we read of "an electric current of ten thousand volts"! It would be just as sensible to speak of water of one hundred pounds, heat quantity of one hundred degrees or money of six per cent when we intend to convey the idea of amount. The correct words denoting quantity which should be used in these connections are an ampere of electricity, a quart or a cubic foot of water, a British thermal unit or a caloric of heat and a dollar or a cent of money. Each of these quantities has no energy or can do no work, which is merely energy applied to a particular purpose until it is moved by some force, such as the voltage of electricity, the heat of water, the temperature of steam or the interest of money.

Energy is an eternal Proteus, indestructible, yet ever assuming new forms. The chemical energy in the cell of a battery is converted to electrical energy, which, in turn, becomes thermal, mechanical or radiant, at our will; the radiant energy in light is transformed to chemical energy in the photographic plate, thermal energy in the conservatory, mechanical energy in the radiometer and electrical energy by indirect means. It is not, however, until energy or work is performed for a definite time that it becomes measurable as power. One ampere under a pressure of one volt for one hour gives the watthour; ten cubic feet per second under a head of ninety feet gives about one hundred horsepower, which is also approximately the power necessary to heat one pound of water seventy degrees Fahrenheit in one second; one dollar at five per cent interest compounded semi-annually has the power of two dollars after fourteen years. Many other examples can be cited, but we believe that these clearly demonstrate the difference between an ampere, a volt, a watt and a watt-hour, or in other words the distinction between a quantity, a force, its energy and its power.

It is argued that common acceptance of a word's definition constitutes sufficient evidence as to its correctness, but this criterion should not be applied to technical words of recognized meaning which may find place in colloquial English. Anyone guilty of loosely using such definite terms not only subjects himself to well deserved ridicule, but also displays his ignorance of a matter upon which he is dependent for many modern conveniences.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. C. Carter of Los Angeles is spending a few days in San Francisco.

Rudolph W. Van Norden has been elected a Fellow in the American Institute of Electrical Engineers.

G. Sherman, stores manager of the Western Electric Company spent a week in Seattle recently.

H. B. Bainard, sales manager of the Western States Electric Company at Seattle, is visiting in San Francisco.

John Coffee Hayes, President of the Mt. Whitney Light & Power Company, of Visalia, was in San Francisco this week.

F. J. H. Price, manager of the vacuum cleaning department of the Sturtevant Company of Boston, is a visitor to San Francisco.

W. W. S. Butler of Stockton has left for an extended trip through the East prior to taking up the electrical field in San Francisco.

B. F. Foss, secretary of the Sturtevant Company, Boston, is in San Francisco, and expects to spend the next three months in California and Pacific Coast territory.

H. B. Keith, formerly engineer in charge of the Nisqually power project, Tacoma, Wash., is now connected with the Puget Sound Iron & Steel Works, in that city.

L. F. Blume, transformer engineering department, General Electric Company, Pittsfield, Mass., was in Seattle recently and will visit transformer installations along the Pacific Coast.

A. W. Woodville, manager detail and supply divisions, in the Seattle office of the Westinghouse Electric & Manufacturing Company, is spending a two-weeks' vacation at Long Beach, California.

E. M. Cutting, manager of the Edison Storage Battery Supply Company, of San Francisco, Cal., has recently completed a trip through Oregon, Washington, Idaho, Montana, Utah and Nevada.

Frank Du Frane, telephone specialist of the Western Electric Company, delivered an address before the Oakland Electric Development League last week on various types of interphones. Some forty members of the League were present.

H. S. Clark, respresentative of Westinghouse-Church-Kerr Company at San Francisco, recently returned from an extended trip through the British Northwest, reports the commencement of repair work at Vancouver, B. C., for the British Columbia Electric Railway System.

Floyd Averill, general manager of the Forbes Supply Company of Portland and Seattle, with his family, is spending a few days in San Francisco on his return from Chicago. Mr. Averill has been attending the convention of National Electrical Jobbers as delegate from the Pacific Coast.

Bert L. Cameron, popular member of the electrical field and for many years connected with the Pacific States Electric Company, was married during the week. The charming bride, Mrs. Gertrude Crowe, was private secretary and treasurer of the same firm. The newly-weds expect to spend several weeks in Southern California.

William H. Spindler, formerly in charge of the electrical department of Rhodes Brothers department store, Tacoma, Wash., and **Clarence A. Richards**, formerly with the Kendrick Electric Company in that city, have formed the Spindler-Richards Electric Appliance Company, with headquarters at 611 Fidelity building, where offices and display rooms will be maintained.

OBITUARY.

Charles S. Potter, proprietor of the Potter Electric Company of Portland, Oregon, died May 27th in St. Vincent's hospital as the result of a blow received on the forehead while cranking his auto Friday, May 23d.

Potter did not realize the seriousness of the injury and continued working, but on the 26th he was forced to his bed. He died a few hours later from a fractured skull. He was 44 years of age and a member of the Ancient Order of United Workmen and Artisans, A. O. U. W., and the National Electrical Contractors' Association. He was highly thought of among his friends and had earned the love and respect of all with whom he came in contact. He is survived by a widow and four children.

MEETING NOTICES.

Jobbers at Del Monte.

The Pacific Coast Jobbers' quarterly meeting will be held at Del Monte from the 4th to 7th of this week.

Oregon Technical Club.

Prof. E. H. McCallister of the University of Oregon, addressed the Oregon Technical Club at the regular luncheon on Monday noon, May 26th. His subject was the "Public Road Work now being done in California."

Mr. L. B. Cramer was chairman of the day, as Mr. H. S. Wells of the Pacific Light & Power Company had been called out of the city on business.

Electrical Development and Jovian League.

Among the many interesting and entertaining speakers who have addressed the League, no one has probably been enjoyed or his words appreciated more deeply than those from Dr. Hartland Law at Tuesday's meeting this week. Dr. Law took for his subject "Salesmanship," dwelling at length upon two rather unusual phases—those of control or mastery of the mind and sensativeness and revealing a most thorough and detailed study of his subject. A Nominating Committee, consisting of Messrs. Kinney, Wiggin and DeRemer, was appointed to make a report at next meeting of nominations for officers for ensuing year.

Pacific Coast Convention of A. I. E. E.

We are able to give further details of the plans for the Pacific Coast Convention of the American Institute of Electrical Engineers to be held in Vancouver, B. C., September 9-11, 1913. The personnel of the whole convention committee representing the Pacific Coast Sections, as appointed by President Mershon, is as follows:

Messrs. R. F. Hayward, chairman, Vancouver, B. C.; E. M. Breed, secretary, Vancouver, B. C.; J. R. Read, Vancouver, B. C.; L. C. Robinson, Vancouver, B. C.; A. C. Routh, Vancouver, B. C.; F. D. Nims, Vancouver, B. C.; E. R. Northmore, Los Angeles, Cal.; J. E. Macdonald, Los Angeles, Cal.; G. R. Murphy, San Francisco, Cal.; A. H. Halloran, San Francisco, Cal.; H. R. Wakeman Portland, Ore.; J. B. Fisken, Spokane, Wash.; J. B. Ingersoll, Spokane, Wash.; C. F. Terrell, Seattle, Wash.; M. T. Crawford, Seattle, Wash.

Sub-committees to take charge of the local work of preparing for the convention have been appointed by Chairman Nims of the Vancouver Section, as follows:

General Committee: Messrs. R. F. Hayward, chairman; E. M. Breed, secretary; F. D. Nims, D. P. Roberts, and J. R. Read.

Papers: Messrs. F. D. Nims, chairman; D. P. Roberts and W. W. Fraser.

Transportation: Messrs. E. M. Breed, chairman; J. R. Read, J. Montgomery, E. R. Pease and H. N. Keifer.

Entertainment and Reception: Messrs. L. G. Robinson, chairman; R. H. Sperling, J. Shand, W. V. Hunt, G. R. Wright, W. J. Lister and C. M. Beebe.

Finance: William McNeil.

The Papers Committee has tentatively arranged a program of seven papers, including one paper to be presented in the evening as an illustrated lecture, with the ladies invited to attend. It is proposed to present only one paper at each session, giving opportunity for far more comprehensive discussion on each paper.

Following the regular business of the convention, which will end on Thursday, September 11, two interesting trips are being arranged for those who are able to prolong their visit through Friday and Saturday—a trip to the turbine-driven hydroelectric development of the Western Canada Power Company at Stave Falls, and an excursion to the impulse-wheel-driven hydroelectric plants of the Vancouver Power Company at Lake Buntzen.

Los Angeles Jovian League.

The Los Angeles Jovians took in 74 new members at their banquet and rejuvenation, which was held on May 22nd at the Union League Club, Los Angeles, Cal. The banquet was free to members and visitors and the total attendance was 111. Ira J. Francis was toastmaster and T. E. Burger, J. C. Rendlu, A. E. Morphy, Geo. A. Damon and S. J. Kuse were speakers. The following menu was served:

MENU

FRUIT COCKTAIL
Chemically Pure

CAVIAR CANAPE
With the Q silent

CELERY
Not obligatory

RIPE OLIVES
Mussed up Plums

CONSOMME PRINCESS
"O Piffle!"

STRIPED BASS
For the mentally deficient

TARTAR SAUCE
Always

SWEETBREAD PATTIES A LA KING
and Queen, Jack, Ten and Nine
(Can't beat 'em unless you cheat)

ROMAN PUNCH
Knockout variety

FILLET OF BEEF AND TRUFFLE SAUCE
Real meat—Small wonder that it costs to live

SPARKLING BURGUNDY
Women and Song reserved for later date

FRENCH PEAS
Inevitable

DUCHESS POTATOES
Garden variety

CELERY MAYONNAISE
Left over from Sunday

FRENCH PASTRY
Galvanized
Can also be furnished
Sherardized

CAMEMBERT CHEESE
Diabolical

DEMI TASSE
Thank God it's over
SELAH

Oregon Society of Engineers.

The following Code of Ethics is being considered for adoption by the Oregon Society of Engineers, and also by the Pacific Northwest Society of Engineers of Seattle:

1. Engineers should be of sterling honesty and moral integrity. Their success and the standing of the profession depend upon their thoroughness, industry, business talent and upright character. They cannot honorably enter into such competition as that which may exist among business men.

2. They should encourage sound engineering learning, by training in scientific schools, by individual study and reading thereafter, and by actual work.

3. Their clients have a right to expect that the portion of business entrusted to them will receive careful investigation and intelligent treatment. Any information which the engineer has derived from such investigation, and which is peculiar to that business is to be considered confidential.

4. In their professional relations engineers should be governed by strict honor and courtesy. Their conduct toward each other should be such that it will secure mutual confidence and good will.

They should not seek to divert to themselves the work or clients of other engineers.

It is the privilege of a client to transfer his work from one engineer to another; but before the change is made there should be a complete understanding between the engineer in charge and the engineer to whom the work is transferred, to avoid offense.

Communications are to be carried on between responsible heads, and not by unauthorized subordinates.

One engineer should not attempt to secure the service of an assistant or employee of another engineer, without first gaining the permission of such principal.

No assistant or engineer's employer should contract his services to another engineer without first consulting his principal.

An engineer should not hinder the advancement of an assistant, but should give him any aid and encouragement possible.

Criticism of another's work is to be broad and unprejudiced. The whole profession is affected by the success or failure of any member.

The relations between principals and their assistants should be those of frankness and mutual helpfulness.

5. Engineers should be willing to assume their proper share of public work, and to render all assistance possible for the general good of the community.

6. An engineer should not attempt work with which he is unfamiliar or inexperienced. In cases of doubt, consultations should be held with other engineers having broader experience.

One engineer should not use language that will impair confidence in another engineer.

7. Fees are to be based on local conditions, and to represent the customary values. One engineer should not seek to undercut others.

8. As far as possible, engineers should not be interested in any business that will prejudice their opinions as applied to their work.

They should not receive commission for materials entering into the work of which they have charge.

They should avoid any unprofessional advertising or appearance of commercialism, but should give other engineers the avantage of the record and publication, wherever desirable, of any unusual or interesting features of their practice.

9. Their attitude toward contractors should be one of helpfulness and tactfulness, combined with firm and just criticism.

An intimate relation should exist between the various branches of engineering.

ELECTRICAL MEN GO IN FOR BASEBALL.

The Portland Coast Leaguers could well take some pointers from the Pacific States Electric Company of the Jobbers' League. With a score of 10 to 0 against them in a game with the Pacific Light & Power team last week, at Sellwood, the Pacific States boys pounded in nine runs in the fourth inning and continued hitting the ball to the close, winning 24 to 12. The batteries were: Pacific States, Hinkley, Brandenberg and Bremmer; Pacific Light & Power, Fox and Good.

THE TRIP OF THE GOLDEN POPPY.

BY A. H. HALLORAN.

Of the several special trains to the N. E. L. A. convention at Chicago, that of the Golden Poppy from San Francisco is of peculiar interest to the Pacific Coast. This train left San Francisco on May 27th as a second section of the Pacific Limited, with a congenial crowd of thirty-eight electrical men and their families, two joining the party at Reno and one at Ogden.

The first few hours were spent in renewing old acquaintances and making new ones, which will certainly prove lasting as a result of the good-fellowship among all enjoying the trip. At Sacramento the local Jovians, headed by Statesman C. V. Schneider, gave the party a gilt-edge welcome, supplemented by magnificent boxes of magnolias for the ladies. This farewell was greatly appreciated, and Sacramento will always have a warm spot in the hearts of all who enjoyed their hospitality.

The trip over the high Sierras and across Nevada was uneventful, except for the appearance of a gigantic elephant near the summit. This beast of burden refused all refreshment offered, except the candy, which was abundantly supplied for the ladies by the Wagner Electric Company, who also furnished cigars and cigarettes in great plenty for the men throughout the entire trip. The Westinghouse Electric & Manufacturing Company also presented each passenger with a leather note-book, and directions for resuscitation, while Pierson, Roeding & Co. distributed whist scores and poker chips, both of which were in great demand, and incidentally put to their proper uses. Mr. T. E. Bibbins of the General Electric Company presented a beautiful bouquet of flowers to each lady each morning, having also provided a General Electric emblem pin to secure them, and consequently was one of the most popular men present. He also distributed decks of playing cards.

Friday morning the "Journal of Electrocution" was on the breakfast table. This clever publication was ably edited by Mr. Tom Collins, who justly earned the reputation as the wit of the party. Many copies of this unique publication were mailed to friends at home, as was also the train directory, which was presented by the Wagner Electric Company.

At Ogden the enthusiastic members of the Utah Electric Club were on hand to wish the travelers bon voyage. Most of the members came up from Salt Lake City, and the party were unanimous in expressing their appreciation of this courtesy, and their regret at not being able to enjoy the program, which had to be abandoned at Salt Lake because of lack of time.

During the afternoon Mr. Morphy of the Southern California Edison Company earned his spurs as a peddler, and added more than his share in promoting the gaiety of the party. By this time also the double quartet was in full voice, and supplemented the entertainment provided by the phonograph contributed by the Eilers Music Company. This phonograph was transferred to each new observation car which the management of the several railroads saw fit to take off and put on to the train at division points. In fact, the changes became so frequent that an indignation meeting was held on Friday evening, which resulted in creating great unanimity of spirit, but was otherwise fruitless.

The oxometer was pressed into service to test the hot air ability of both peddlers and central station men on Friday night, Mr. Pierce being given the highest rating as the Best Spieler, and receiving the "gentlemen's prize" presented by G. I. Kinney of Fort Wayne Electric Company.

Saturday's big event was a card tournament for handsome electric heating devices, conducted by the General Eltctric Company, Holabird-Reynolds Company and Westinghouse Electric & Manufacturing Company. In the bridge game the highest score was made by George Campbell, Miss Metcalfe being a close second, and Mrs. Campbell receiving the consolation prize. In "500" Carl Heise was high man, Miss Strong of the Southern California Edison Company second and Halloran low man.

Saturday night's entertainment was furnished by the irrepressible Morphy, ably abetted by Tom Collins. It is sufficient to add that they probably enjoyed it more than did their non-sleeping victims.

The crowd reached Chicago by noon Sunday, ready for the strenuous activities of the convention week. It is to the credit of the California delegation that they represent the greatest passenger-mileage in attendance, the figure being slightly above 100,000.

NEW SECRETARY OF PACIFIC COAST ELECTRIC RAILWAY ASSOCIATION.

Mr. H. C. Hazzard has accepted the position of permanent Secretary of the Pacific Coast Electric Railway Association, which was organized on April 1st last, and includes the various electric lines in the States of California, Oregon and Washington. He will assume his duties on July 1st, and will be located in Portland, Oregon.

Mr. Hazzard is a Californian, but has resided in the East for the past ten years. He was connected with the first Railroad Commission appointed by Governor Hughes of New York, and recently severed his Eastern connections to be identified with the California State Railroad Commission, from which he is now resigning.

TRADE NOTES.

Kilbourne & Clark Manufacturing Company, Seattle, is filling an order for radio telegraph rotary converters, recently received from England.

Charles C. Moore & Company are installing a 150 horsepower Stirling boiler in the Merchants' Exchange Building plant at San Francisco, Cal.

J. J. Agutter & Company, Seattle, Wash., have the electrical installations well under way in the Elks' Club building at Fourth avenue and Spring street.

The Puget Sound Traction, Light & Power Company is getting ready to extend its tracks on Spokane avenue at the Ferry landing, a distance of approximately 1000 ft.

NePage, McKenney & Company of Seattle, Wash., have the contract for the complete electric lighting, power, telephones and fixtures in the McBride opera house at Victoria, B. C., amounting to $15,000.

Evans-Dickson Company, Tacoma, Wash., have been awarded an additional contract for installing an engine set, rotary converter and switchboards at Fort Casey, Washington, the contract approximating $3000.

The Westinghouse Electric & Manufacturing Company has received an order from the Anaconda Copper Mining Company for 2-1200 h.p., 2400-volt, 3-phase, 60-cycle, 75 r.p.m., synchronous motors for direct connection to cross-compound compressors.

Evans-Dickson Company, Tacoma, Wash., have the contract for electrical installations in the four-story Pacific Brewing & Malting Company building, also similar work for the park board in the Point Defiance unloading station now under construction.

NEW CATALOGUES.

The Sprague Electric Works of the General Electric Company have issued catalogue No. 439, which contains descriptions of the Sprague conduit products.

The Edison Storage Battery Company Orange, N. J., has issued an attractive booklet, describing the Edison Battery, in use for house-lighting plants. The book is illustrated with many views taken from a house equipped with one of the Edison sets, showing the arrangement of lights, heating devices, fans, washing machine and other electrical conveniences.

INDUSTRIAL

WESTON MINIATURE DIRECT-CURRENT INSTRUMENTS.

The Weston Electrical Instrument Company of Newark, N. J., after making many models, has developed a line of miniature instruments of the permanent magnet movable coil type for the measurement of current and voltage, including voltmeters, ammeters, volt-ammeters, special battery testing voltmeters, and milli-ampere meters. Single, double and triple range instruments may be obtained, in various combinations.

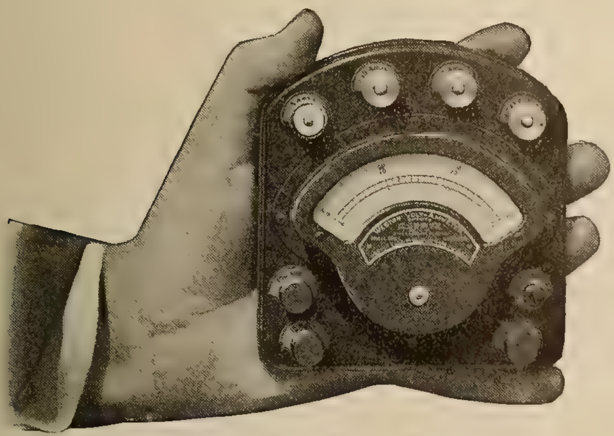

Fig. 1.—Portable Voltmeter.

These instruments are carefully made, and are very compact. They weigh less than a pound and may easily be carried in the pocket. The pointer of the portable form is knife-edged to permit close reading. The scale length is 2¾ inches. They are made as carefully and as conscientiously as the highest grade Weston apparatus.

The movable system of these instruments is extremely light, weighing less than 0.2 gram (less than the weight of two common pins). This system is magnetically damped, and comes to rest quickly after the application of current. In fact, not more than about 1/5 second will elapse before the pointer comes to rest in any new position due to changes in current or e.m.f.

Both portable and switchboard types are shielded against external magnetic fields and are practically unaffected by changes in temperature.

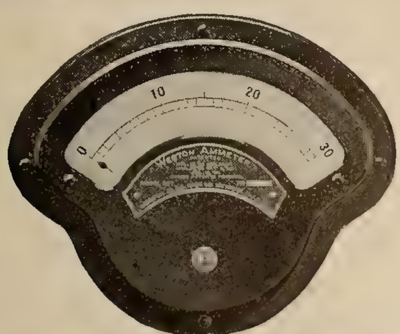

Fig. 2.—Miniature Switchboard Meter.

Fig. 1 shows a triple range portable volt-ammeter one-half actual size, the outside dimensions being 4.4 by 4.6 inches. With this instrument any e.m.f. from 150 volts to 0.02 volts and any current from 30 amperes to 0.05 ampere may be measured.

These miniature instruments serve many useful purposes. In high schools and colleges the results obtainable with them are more than equal to class room and laboratory requirements, and their low price permits their extensive introduction, so that each student working in a laboratory may be provided with an instrument.

The miniature switchboard meter shown in Fig. 2 is one-half actual size. The movements in these instruments are practically identical with the portable models, but a pointer with a pear-shaped tip is used to permit readings at a considerable distance. These instruments are all single range and back connected.

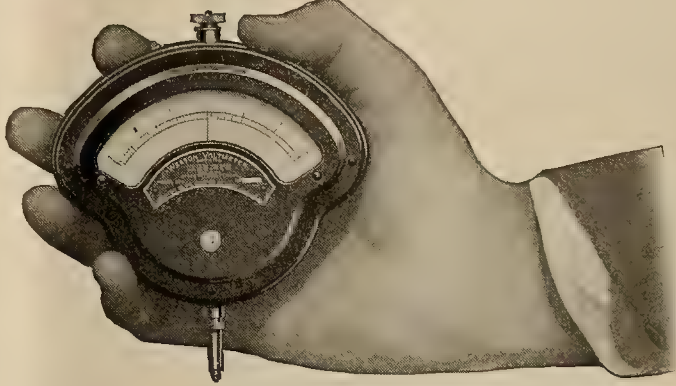

Fig. 3.—Battery-Testing Voltmeter.

They are made in numerous ranges from 50 milli-amperes to 30 amperes, and from 50 milli-volts to 150 volts. These instruments are specially useful in all cases where size and weight are important factors, and with the advantage of low first cost, serve excellently in connection with automobile self-starters or headlight batteries, small isolated plants, apparatus for physicians' use in electro-therapeutics, dental work, etc.

Fig. 3 represents a battery testing voltmeter, one-half actual size. These are provided with a steel point at one terminal which is removable, and may be replaced by a regular binding post nut. To the other binding post may be attached a flexible cord with another point supplied with the instrument.

Fig. 4 illustrates switchhoard volt-ammeters designed specially for storage battery charging outfits for automobiles

Fig. 4. Switchboard Voltmeter.

and other small installations where it is necessary or preferable to use one instruments to indicate both volts and amperes. Normally it indicates the charging or discharging current, but when pressure is applied to the contact button the pointer will indicate volts.

NEWS NOTES

INCORPORATIONS.

BOISE, IDAHO.—The St. Anthony Power Company, Ltd., has been incorporated for $250,000 to construct and operate power plants with Ashton as the principal place of business. Officers: A. Whitten, Blackfoot, president; H. C. Graves, Ashton, vice-president; W. L. Robinson, Ashton, treasurer.

ILLUMINATION.

NYSSA, ORE.—The Beaver River Power Company expects to enter this field in the near future.

LOS ANGELES, CAL.—Herbert J. Goudge and Paul Overton, counsel for the Los Angeles Gas & Electric Company, appeared in opposition to the application of the Economic Gas Company, before Commissioner Eshleman for approval of its bond issue. The Economic quite recently issued $930,000 first mortgage 5 per cent bonds, out of a total issue of $1,500,000 and disposed of them at 83.33. The company is now applying to have its action ratified. Counsel for the Los Angeles Gas & Electric Company interposed a formal protest on the ground that the money derived from the bond sale had been used in invading its territory in the city of Los Angeles and paralleling its mains.

LOS ANGELES, CAL.—The city council, at the conclusion of a public hearing denied all protests and sustained the electric light and power rates, as fixed by the board of public utilities, for the fiscal year commencing July 1. This action means that the electric light rate, commencing July 1, will be reduced from 6½c to 6c and the power rate from 6c to 5c, for the first 100 kw. hours consumed in one month. Approximately 74,000 light and power consumers will be benefited by the reduction and these consumers will save about $250,000 a year, according to the estimate of officials of the utilities department. The new rates fixed by the utilities board and approved by the council were recommended by James E. Barker, the board's engineer, who made a thorough investigation of valuations, and is of the opinion that the companies will receive a just and reasonable return on their investments.

TRANSMISSION.

BOISE, IDAHO.—Secretary of Interior Lane has allotted $38,000 from funds now available for construction of the Arrowrock dam, Boise irrigation project, Idaho, for power development.

MARTINEZ, CAL.—The contract for the erection of a reinforced concrete substation and powerhouse on the line of the Great Western Power Company, near Antioch, where the power line spans the San Joaquin River, has been awarded to the Reardon-Crist Construction Company, for $8000.

BOISE, IDAHO.—Reports that will not down are going the rounds locally that W. H. Bancroft, general manager of the Harriman interests in this section, is negotiating for the purchase outright of all the power interests and all the interurban traction interests in this section of Idaho. This deal, which the reports have it are now well underway, includes the Kuhn power interests, the Beaver River Company holdings, all the interests of the Idaho-Oregon Light and Power Company and all the interests of the Idaho Traction Company.

SANTA BARBARA, CAL.—Merging of all the electrical power interests in Santa Barbara, San Luis Obispo and Fresno counties into one corporation is the scheme afoot which seems destined to prove a large factor in this county. Involved in the plan is one to absorb also a number of gas and water corporations, bringing all under the control of one management. It is understood that the Kirckhoff-Balch interests, which are back of the San Joaquin Light & Power Company, are backing this new scheme of consolidation and expansion.

SPOKANE, WASH.—A group of Spokane capitalists have concluded the purchase of the Nixon-Kimmel Company's power plant on the Methow River, just above Pateros, now supplying power and light for Pateros, Bridgeport and Brewster. They have also purchased the power and light distribution system at Okanogan, Wash. These men are now organizing a $300,000 corporation, which will probably be known as the Okanogan Valley Power & Light Company, for the purpose of supplying power and light for the rapidly developing Okanogan district. Eugene Enloe is president of the new corporation; S. E. Gates, vice-president, and W. C. Sivyer, secretary-treasurer. These men are now associated in the Big Bend Light & Power Company which supplies light and power to seven towns in the Big Bend country. They also have the Grangeville Light & Power Company, supplying nine towns in the rapidly developing Grangeville district.

ELY, NEV.—J. P. Martin, district engineer for the Forest Service in company with Supervisor Thompson of the Nevada National Forest. last week visited Cleve Creek to make formal inspection of the stream to report on the application of W. Lackner, of Salt Lake, for permission to utilize the stream for generating electric power. The stream being within the boundaries of the Nevada National forest, it is necessary that permission from the service shall be obtained by anyone desiring to use the water in any way. If the application of Mr. Lackner is approved, he will be permitted to erect a power house at the mouth of the Cleve Creek Canyon and construct a conduit 5000 ft. long with a 450 ft. head to convey the waters of the stream to it; assuming that he also has permission from the State of Nevada to use the water for power purposes. On approval of such applications the service grants a preliminary permit covering a period of one to two years. If the proposed power plant is to really be constructed then the applicant is given a 50 year permit.

TRANSPORTATION.

ASHLAND, ORE.—The Jackson County Court has granted a franchise to S. S. Bullis of New York, to operate interurban trolley lines upon public highways throughout the county. The terms imply that one mile must be built and operated within a year.

SAN DIEGO, CAL.—As soon as the city can establish a satisfactory grade, John D. Spreckels will extend the Ocean Beach Electric car line from a point just beyond Loma Portal through Rossville and La Playa to Fort Rosecrans military reservation.

SACRAMENTO, CAL.—The line of the Central Traction Company will, it is reported, be extended to Consumnes within the next few months. It is understood that when the line has been extended to that point arrangements will be made to build it on to Jackson in Amador county.

LOS ANGELES, CAL.—Because of numerous protests filed with it, the board of public utilities proposes to hold a public hearing on the application of the Pacific Electric Company for a franchise to construct and operate a double

track elevated railway from the rear of its Sixth street depot to San Pedro street, there to connect with the municipal line to be built between Aliso and Ninth streets on San Pedro street.

OAKLAND, CAL.—The resignation of E. A. Heron, president of the traction interests merged in the San Francisco-Oakland Terminal Railways, has been accepted by the reorganized board of directors of the company, and William A. Bissell, traffic manager of the Santa Fe, has been elected president. James K. Moffit, vice-president of the First National Bank of San Francisco, and a member of the trustees operating committee and of the company's directorate, was made vice-president to fill the vacancy caused by Mr. Bissell's advancement to the presidency. W. R. Alberger, vice-president and general manager, will, it is said, retain his position, as will Secretary F. W. Frost.

SAN FRANCISCO, CAL.—The State Supreme Court has removed all legal obstacles to the enforcement of the agreement between the city and the United Railroads for the use of the outer tracks on Market street from Sutter street to the city front, and within 40 days the municipal cars will be operating down Market street from Geary to the Ferry. The United Railroads' Sutter street cars are already running to the Ferry. The contractor for the Geary street tracks and those of the United Railroads on Market, F. Rolando, expects to have the connection established within 30 days. The United Railroads and city must share the expense and maintenance cost of the outer tracks from Sutter and Market to the Ferry. The city must pay to the United Railroads one-half the value of the outer tracks, the value not to exceed $25,000. The Sutter Street railway on Market from Sutter to the Ferry is declared annulled save for those franchise rights extended by the agreement. At midnight of November 14, 1919, the agreement shall become automatically annulled and the United Railroads is then under obligation to sell its share in the outer tracks to the city.

SACRAMENTO, CAL.—As soon as the Colusa branch of the Northern Electric is turned over to the operating department of that railroad, the construction department which is now completing that line, will turn its attention to the lines beween Sacramento and Vallejo, formerly known as the Vallejo and Northern and which will establish, by means of boat service from Vallejo to San Francisco, new electric service between Sacramento and San Francisco. The first work to be done by the construction department of the railroad will be to complete the ten-mile line between Vacaville and Suisun. Six miles of this branch already has been built out of Suisun. When this branch line is completed all energies will be turned toward the completion of the direct line between Vallejo and Sacramento, a distance of about 60 miles. The terminal has been completed at Vallejo and construction work will proceed out of that city toward Suisun through the Cordelia Hills. From Vallejo the main line will make a direct route for Sacramento, a distance of 30 miles. After the main line from Sacramento to Vallejo is finished, it is the announced intention of the company to complete a line from Woodland to Vacaville.

TELEPHONE AND TELEGRAPH.

COLFAX, CAL.—The commission has granted authority to Carl G. Bell and John L. Butler to purchase the telephone exchange of John B. McCleary.

BISBEE, ARIZ.—P. C. Gattins, district manager of the Mountain States Telephone & Telegraph Company, states that the company is getting figures on a number of proposed lines in the northern part of the state. One of the first lines to be increased will be that between Tucson and Benson. This will be the basis for opening up considerable territory to the north.

WATERWORKS.

SANTA CRUZ, CAL.—Preliminary steps were taken at a recent meeting of the city council for the calling of a bond election for the redemption of the waterworks.

KALISPELL, MONT.—The city is contemplating purchasing the water works now owned by the Northern Idaho & Montana Power Company. The council has engaged consulting engineers to estimate the cost of a new water works system and also appraise the value of the existing water works system.

OLYMPIA, WASH.—An ordinance providing for the construction of a water system and issuance of $150,000 bonds in payment was read at the last meeting of the council. Summit Lake in the Black Hills, 12 miles from Olympia, will be the source of supply. The bonds will be payable in blocks from $6000 to $14,000 each year after 1917, running as long as 1932. They will bear 6½ per cent interest. The system will be constructed to discharge 2,500,000 gallons every 24 hours, into a 3,000,000 gallon reservoir. It will be constructed on the W. C. Dobbin donation claim.

SAN JOSE, CAL.—Commissioner Gordon presided at the hearing of the application of the San Jose Water Company for leave to buy certain riparian rights and other water rights from the Pacific Gas & Electric Company and to issue $100,000 of notes, secured by its water system, which supplies Los Gatos. Manager Rylands of the water company explained, in reply to C. P. Cutten's questions, that many years ago his company entered into a contract with a predecessor in interest of the Pacific company to supply it with water for power and that subsequently the Pacific company secured riparian rights on the creek, that was the water company's source of supply. The water company is willing to pay $25,000 for these water rights and the release of this contract. The matter was taken under advisement..

SAN FRANCISCO, CAL.—City Engineer O'Shaughnessy is arranging to proceed with the appraisement for the city which President Bourne of the Spring Valley Water Company insists should be made of the corporation's property. Mayor Rolph says any renewal of purchase negotiations will mean no loss of time, as the new law allowing the city to bring the suggested condemnation suit in a single county will not be effective until 90 days after its approval. The finance committee has put over for a week the proposal of the public utilities committee that $100,000 of water supply bond issue funds be appropriated for the purchase of pipe to be used in extending the Spring Valley's local distributing system. There is now available of such funds only $114,000, and more bonds must be sold before any heavy drain is made upon them. Any appropriation for pipe must be confined to $75,000.

SAN RAFAEL, CAL.—The engineers of the muncipal water district of Southern Marin have filed their report. The engineers find that there are four sources of water supply available. The first is the Bon Tempe system with a reservoir site on the big flat between Liberty and Fairfax. Including main supply pipes this system, it is estimated, would cost $1,751,257. The Alpine gravity system on Lagunitas Creek, would cost $1,998,857. The Alpine pumping system would cost $1,765,857, and the Alpine independent system would cost $1,821,400. The report also states that the development of a water supply on the Russian River is perfectly feasible. The estimated value of the plants of the several water companies now furnishing the supply here is given as follows. Marin Water & Power Company, $896,697; North Coast Water Company, $250,500; Sausalito Municipal Plant, $124,613; Sausalito Land & Ferry Company, $17,423; H. A. Boyle, Tiburon, $3100; American Land & Trust Company (Larkspur), $11,597; Doherty Company, Corte Madera, $8665; Mailliard Estate, Lagunitas, $10,034; E. C. Chapman, Corte Madera, $15,760.

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR RENT.—1270 square feet storeroom; 10-foot ceiling; on Natoma street, near New Montgomery; use of 11-foot 2-ton elevator; rent $25.00 per month. Address Box 18, Journal of Electricity, Power and Gas.

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Electric Appliance Co.
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American Ever-Ready Co.
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"Flexduct," "Flexsteel," "National Metal Molding Co.
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D. & W. Fuse Company
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D. & W. Fuse Company
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Pacific States Electric Co.
Sprague Electric Works
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General Electric Company
Pacific States Electric Co.
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Benjamin Electric Mfg. Co.
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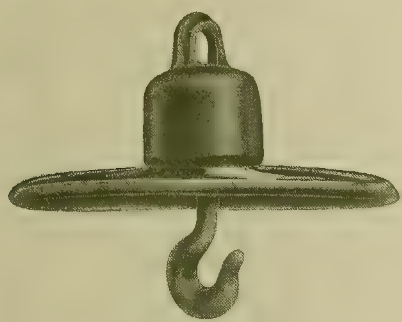

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages, 9, 10.

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VOLUME XXX | SAN FRANCISCO, JUNE 14, 1913 | NUMBER 24

PROBABLE WATER SUPPLY

BY ALEXANDER McADIE.

There was a pleasing story current in academic circles forty years ago that Agassiz said: "He could not stop his biological work long enough to make money." This is a good team mate to that other tale which comes from the classics, that one Thales (yes, the same man that rubbed amber and thus became the first electrician) was twitted by the citizens of Athens concerning his large stock of knowledge and small stock of money. Now Thales must have been a student of wet and dry seasons, for surmising that the season would be one of abundant rainfall and heavy olive crops, he secured an option on all the presses in Attica. Later in the season when the olive growers found themselves blest with heavy crops, they had to pay whatever bonus Thales saw fit to require,

It is certainly a matter of prime importance to all of us in California to have some advance knowledge of the character of the season as controlling the supply of water available for irrigation, power, stock and other usages. Considering the state as a whole there are certain definite relations between distribution of atmospheric pressure and excess or deficiency in rainfall. Thus the character of the season is found to bear a direct relation to the position and intensity of the so-called centers of action, or in briefer terms, the hyperbars and infrabars. Similar relations are known to exist in other parts of the world.

Fig. 1. Model of Depth of Snow Curve for Various Seasons at Summit, Cal.

A striking example of this law of seasonal variation occurred in the months of January and February, 1902. During the dry month, January, the deficiency in rainfall throughout California determined by records from 200 stations, was 80.52 mm. (3.71 in.) This meant an actual withholding from the state of 33,000,000 acre feet. Here then was a dry winter month with every prospect of a shortage in water for the coming spring and summer. But what happened? There was a marked change in the position and intensity of the Aleutian low (the infrabar) and the

Continental high (the suprabar) with the result that February was abnormally wet and even in the short month there was an excess of 131.3 mm. (5.17 in.) or practically 43,000,000 acre feet over and above the average for February.

Another remarkable season was that of January, 1909, when nearly twice the average January rain fell in the state, and even at so early a date as the end of January it was plain that there would be no scarcity of water notwithstanding floods, excessive runoff and general waste. February, 1909, was also excessively wet, while March was a month of moderate rainfall.

rent of air passing over a mountain range loses its load of water vapor in ascending and on the other hand gains heat in descending, thus becoming a desiccating wind, such as the chinook, foehn or familiar norther of our section. Such a wind will carry off snow at an astonishingly rapid rate. Some rough calculations which we have made show that such a condition will reduce the depth of the snow from 8 to 10 in. in 24 hours, whereas the normal rate of melting on a warm but still day, would be but 3 in. And this water does not remain in California.

The first factor, ordinary melting, is effective after the middle of March. In the Journal of Electricity,

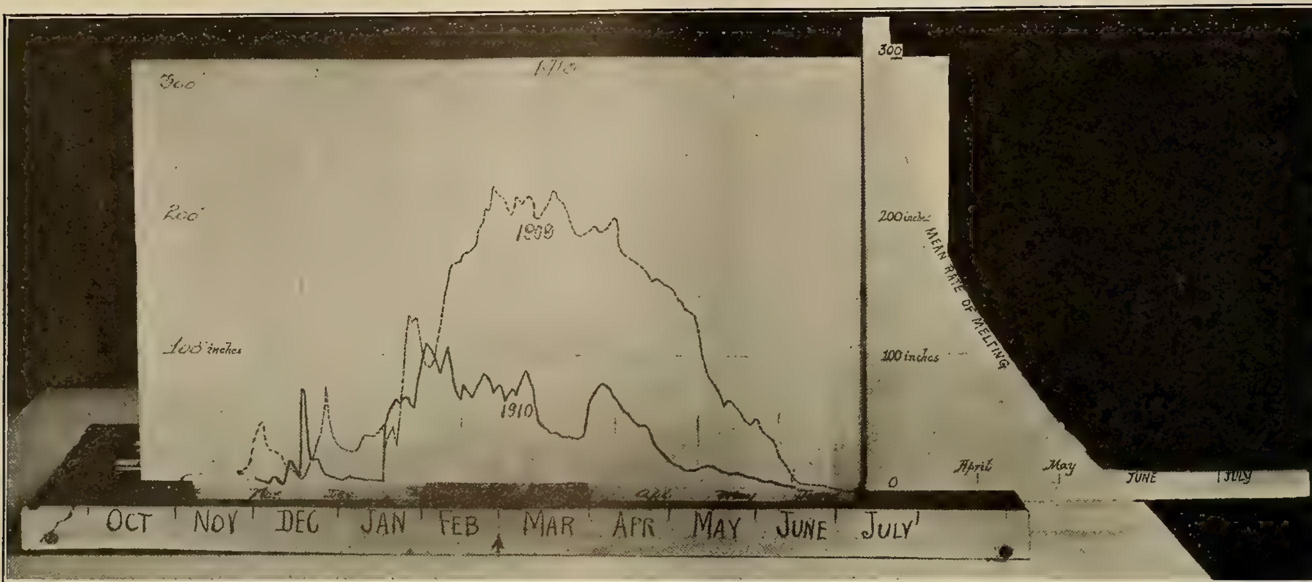


Fig. 2. Comparative Depths of Snow, Two Seasons.

The present season is interesting inasmuch as January was a month of nearly average water supply, while February had only about half and March less than half the normal. Notwithstanding the possibility of rain in June and even July, it is plain that the amount of water which has fallen in the form of rain is insufficient for the general needs and will have to be supplemented from storage supplies or ground sources.

It is also of interest to study the depth and extent of the snow cover in the mountains; and for this purpose records of the depth of snow on the ground at Summit, Placer county, elevation 7010 feet, have been compiled and arranged in such form as to enable comparison between good and bad seasons. In a general way the snow cover is a good index of the character of the season and perhaps the best indicator yet available for forecasting the probable water supply and the river stages. This frozen storage, as John Martin termed it years ago, dissipates in four ways: first, by melting or runoff; second, by evaporation or flyoff; third, by percolation, seepage or sink-off, and fourth, by absorption of forest cover, which for lack of a better name, we may call the holdup. This water of vegetation may be in part re-evaporated from leaf surface, thus constituting what might be called a "second pick-up."

Of these four factors, the second, namely, evaporation, is perhaps the most effective in California. There are certain thermodynamic reasons why a cur-

Power and Gas, March 25, 1911, the writer discussed the probable rate of melting and gave diagrams for comparing the actual rate for any given season with the mean rate, so that the probable date of the disappearance by melting may be determined.

The third and fourth factors can not easily be determined except by systematic measurement; and some steps have been taken toward the accomplishment of this by officials of the Weather Bureau and Forest Service. There has also been some interesting work done by Professor J. E. Church Jr., of Reno, Nevada, in connection with the retardation of melting with elevation in the Tahoe Basin. He uses a combined snow sampler and weighing gage of his own invention for approximate measurement of the water content of the snow under varying conditions of depth and exposure.

For many years the record of the depth of snowfall has been recorded at Summit and card-board profiles, drawn to scale (1 to 40) have been utilized in studying the probable water supply in the central portion of the Sacramento valley, more particularly the watershed of the American River.

It occurred to the writer that it might be possible to utilize the difference between the depths in various years in connection with stream flow measurements for the same period and that such a differential method might enable us to determine what portion of the total depth of snow on the ground disappeared in the form of runoff.

Fig. 1 shows the model in use by the writer for determining the probable water supply based upon depth and extent of snow cover. It is evident that in the two seasons, 1911-12, and 1912-13, the runoff ought to show minima values. Whereas during the seasons 1906-07, 1908-09, 1910-11 there was ample water and runoffs far above the normal. The only available station for comparison is at Fair Oaks. Data given in Water Supply Paper No. 298, U. S. Geological Survey, are as follows:

Total runoff in acre feet:

1912-13 to date	1,000,000 (estimated)	1908-09	4,540,000
1911-12	1,160,000, incomplete	1907-08	1,450,000
1910-11	6,480,000	1906-07	5,710,000
1909-10	3,540,000		

From the snow depth record one is reasonably certain that the present season in the matter of runoff will resemble the season of 1911-12.

Some monthly comparisons are:

		Acre ft.			Acre ft.			Acre ft.
Jan.	1907	255,000	Feb.	1907	822,000	Mar.	1907	1,520,000
	1908	160,000		1908	113,000		1908	202,000
	1909	1,490,000		1909	861,000		1909	397,000
	1910	524,000		1910	291,000		1910	646,000
	1911	855,000		1911	589,000		1911	799,000
	1912	68,200		1912	44,800		1912	118,000

Instead of depth of snow a truer measure of the runoff is the total precipitation, which includes rain and snow. The reduction factor generally used is 10. Of course the relative density of the snow is and always must be an uncertain quantity depending upon the age of the cover, the wind action in packing, the temperature factor and the original conditions of congelation. In the data under consideration the writer by actual measurement, melting snow samples in a cover 12 ft. deep, found that it required about 20 in. of the loosely packed snow, freshly fallen, at the top of the cover to make 1 in. of water; while 4 in. of the snow, which was almost ice, taken from the bottom of the snow cover, made 1 in. of water.

The following are the total precipitations:

		Inches.			Inches.			Inches.
Jan.	1907	13.50	Feb.	1907	4.38	Mar.	1907	27.36
	1908	3.50		1908	4.50		1908	10.20
	1909	29.44		1909	8.94		1909	4.60
	1910	8.60		1910	5.10		1910	4.98
	1911	28.90		1911	5.30		1911	10.63
	1912	3.24		1912	0.46		1912	6.10
	1913	13.60		1913	2.05		1913	3.20

The following notes are of interest in connection with the measurements:

February, 1907—Snow very wet.

March, 1907—Snow abnormally heavy.

January, 1908—A marked decrease in precipitation at levels above 3000 ft.

January, 1909—Abnormally heavy rain and snow. Also heavy runoff, possibly due to saturated condition of ground.

January, 1911—Unusually heavy precipitation, but runoff light. Notwithstanding the fact that more rain fell in the drainage basin of the Sacramento valley than during any previous January, the water courses were much below the normal. The explanation of this is that the rains were mostly in the nature of warm showers. There was less precipitation in the mountain sections than at sea level. Moreover, the precipitation in the mountain sections did not equal that of January, 1910.

One interesting and new factor comes out of this discussion, namely, that in certain storms in California there is not the usual increase in amount of precipitation with elevation; but on the contrary a maximum rate prevails below the 1000-meter level. Ordinarily the precipitation increases with elevation up to nearly the 2 kilometer level. This is of some importance in connection with the selection of reservoirs.

THE ECONOMIC STATUS OF THE STREET CAR SYSTEM OF SAN FRANCISCO.

BY F. K. BLUE.

(Continued.)

Operation by the United Railroads, With Adequate Service.

If the present franchises are operated with adequate equipment and service as recommended by Mr. Arnold, an immediate additional investment of $7,000,-000 and a somewhat greater investment in betterments until the franchises expire will be required. The operating expense must also be increased. Under such conditions it is estimated that the total physical investment would amount to $39,000,000, and that the property would be maintained permanently in such a good operating condition that it could be liquidated at three-fourths of its value as the franchises expire. The present worth of the total investment of $18,000,000 required for betterments under these conditions is $13,500,000. which added to the present tangible value of $21,000,000, makes $34,500,000 as the present value of the cost of the whole required investment.

The total gross earnings of the company is assumed to be as before, but with improved service the cost of operation is assumed to require 67 per cent of the gross receipts (see Report, p. 84). This will leave a net income of 33 per cent of the gross receipts, which would amount to a total of $91,560,000 during the 40 year period. The present value of these income items as distributed over the period is $44,570,-000. Three-quarters of the physical investment would amount to $29,250,000, the present value of which, as liquidated at the expiration of the corresponding franchises, would amount to $7,360,000. Adding this to the present value of the income we have $51,930,000 as the present value of all the resources of the property. Subtracting $34,500,000, the present value of the required investment, we have $17,430,000 as the present value of the franchises under conditions of adequate service and equipment. This represents the present value of the free gift that was made to the street car companies provided a reasonable service is secured but a lower fare cannot be required. This franchise value represents 13 per cent of the gross receipts, so with adequate service all franchise value would be destroyed by the reduction of the fare to 4.35 cents. With the present service all franchise value would be eliminated if the fare were reduced to 3.86 cents.

Operation of Whole System by a Private Company, With Adequate Service.

According to Fig. 2 the whole physical investment for the complete street car system of the city which would be required by the year 1952 when the last of the present franchises expires would amount to $131,000,000. The present value of the future betterments required to complete this system is $40,250,-000, which, added to the present tangible value of $21,-000,000, amounts to a present value of the required cost of the whole system of $61,250,000.

The total gross receipts for the complete system for 40 years is estimated at $970,060,000. Allowing 67 per cent of the gross receipts for adequate service, as before, the total income during the 40 years would

amount to $320,170,000, the present value of the items of which is $91,550,000.

Assuming the property to be maintained at three-fourths of its cost, as before, its physical value in 1952 would be $98,250,000, the present value of which at 6 per cent interest is $9,550,000, which, added to $91,550,000, the present value of the income items, amounts to $101,100,000, which is the present value

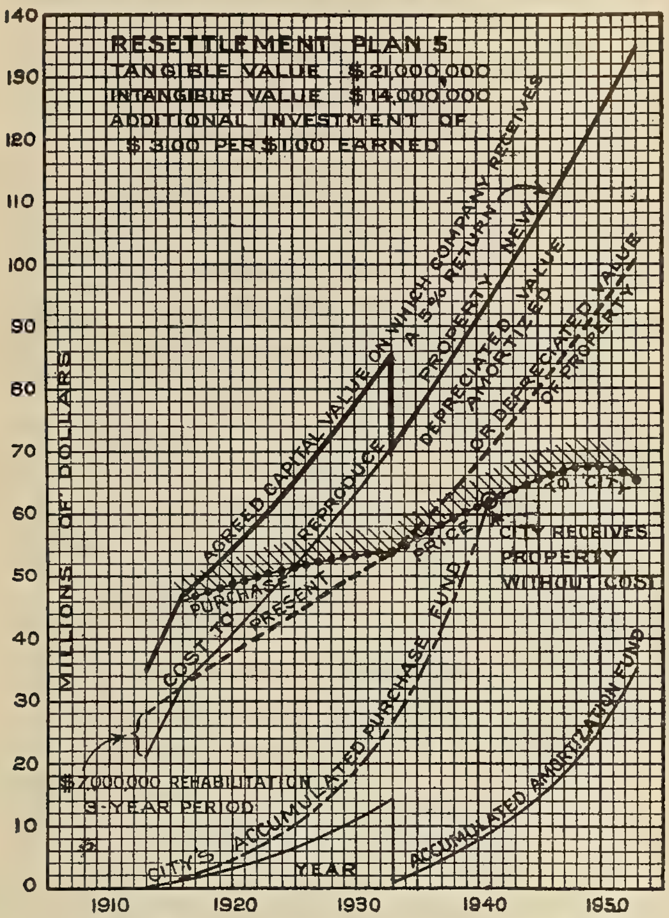


Fig. 2. Profit-Sharing Resettlement Plan 5.

of all the resources of the entire street railway system of the city for forty years at 6 per cent. This is not far from its present value in perpetuity, since the present value of a perpetual annuity at 6 per cent is but 11 per cent greater than the present value of the same annuity for forty years.

Subtracting the present value of the required investment, we have $39,850,000 as the total present franchise value of the complete street car system of the city for forty years at 6 per cent, under conditions of adequate service.

Operation by the City of That Part of the Complete System Not Covered by the Present Franchises.

The investment required by the city is taken as the difference between the investment required for the complete system and that required by the United Railroads under conditions of adequate service, to which is added the amounts liquidated by the United Railroads, at three-fourths of cost, at the time of the expiration of their franchises. The total amount of these items of cost is $121,250,000 for the 40 years, the present value of which is $34,150,000.

The gross receipts is likewise taken as the difference between the gross receipts from the whole system and the receipts estimated for the United Railroads. The estimate for the cost of operation, however, must be increased on account of charter requirements in regard to wages and hours. An examination of the present distribution of operating expenses, as shown in Table 31 and in the discussion on page 387), shows that under charter conditions the wage expense of operation would be increased about 50 per cent. This would increase the total operating expense from 67 per cent to about 78 per cent of the gross earnings, leaving 22 per cent for net income. At this rate the total income to the city during the 40 years would amount to $152,520,000, the present value of which would be $31,340,000. This present value is proportionately smaller than in the case of the United Railroads not only on account of a difference in labor conditions but also on account of the greater part of the income accruing much later in the period.

Since the city would have acquired the complete system at the end of the 40 years the present value of the system depreciated to three-fourths of its cost would be $9,550,000 as before. Adding this amount to the present value of the income we have $40,890,000 as the present value of all the resources for 40 years of that part of the entire street railway system not covered by the present franchises.

Subtracting the present value of the required investment, we have $40,890,000—$34,150,000 = $6,740,000 as the present franchise value to the city of that part of the complete street car system of the city for forty years that is not covered by present franchises, when operated under the conditions required by the city charter.

Whole System Operated by the United Railroads Under the Proposed Charter Amendment No. 34.

Under the conditions of "Resettlement Plan 5" shown in Fig. 2, and recommended by Mr. Arnold, the United Railroads must invest $7,000,000 in three years to rehabilitate the property, and must thereafter keep the investment at three times the amount of the yearly gross receipts. The present tangible value of the property is assumed to be $21,000,000. to which the amounts for rehabilitation, betterments, and extensions are added to form the value of the tangible investment. For the first 20 years $14,000,000 is constantly added to this tangible investment to form an "agreed capital value" upon which a prior return of 5 per cent is allowed to the Company before a division of the profits is made. The operating and maintenance expense is assumed to be 67 per cent of the gross receipts, and 3 per cent of the gross receipts is placed in a fund at 5 per cent interest to be used in paying the security holders the $14,000,000 intangible value at the end of 20 years, and then the remainder is placed to the credit of the City towards the purchase of the property. This leaves an income of 30 per cent of the gross receipts from which the prior return of 5 per cent of "agreed capital value" is subtracted, leaving a residual net income which is allotted in the proportion of 55 per cent to the City and 45 per cent to the Company.

The total investment in betterments and extensions required from the United Railroads under this plan would be $110,000,000, the present value of which is $40,250,000, which added to the $21,000,000 present

Operation by	Income Percentage of Gross Receipts.	Present Value of Net Returns.	Present Value of Sums Liquidated.	Present Value of Total Income.	Tangible Investment in 1912.	Present Value of Future Investments in Betterments and Extensions.	Total Present Value of Real Investment.	Present Franchise Value.	Actual Interest Rate Realized on Real Investment.
	%	Millions,	Millions.	Millions.	Millions.	Millions.	Millions.	Millions.	%
1. U. R. R. for maximum profit	40	53.99	2.35	56.34	21	5.06	26.06	30.28	13.7
2. U. R. R. with adequate service	33	44.57	7.36	51.93	21	13.50	34.50	17.43	9.4
4. City	22	31.38	9.55	40.89	0	34.15	34.15	6.74	7.3
Total of 2 and 4		75.91	16.91	92.82	21	47.65	68.65	24.17	8.4
3. Complete system by private company..	33	.91.55	9.55	101.10	21	40.25	61.25	39.85	10.3
5. U. R. R. under resettlement plan......	33	69.09	9.55	78.64	21	40.25	61,25	17.39	7.9
City's share under resettlement plan ...	33	21.38	0	21.38	0	0	0	21.38	∞
Sum under resettlement plan		90.47	9.55	100.02	21	40.25	61.25	38.77	10.2
6. U. R. R. under self-adjusting rate-fixing method	33	70.23	9.55	79.78	21	40.25	61.25	18.53	8
City's share under self-adjusting rate-fixing method	33	21.32	0	21.32	0	0	0	21.32	∞
Total under self-adjusting rate-fixing method	33	91.55	9.55	101.10	21	40.25	61.25	39.85	10.3

Note the franchise value, 24.17, is less than 39.85 on account of difference in labor conditions, and that 38.77 is less than 39.85 on account of amortization fund at 5% interest instead of at 6% in the securities of the company.

physical value makes the total present value of the cost of the investment $61,250,000 as before.

The 5 per cent prior return on "agreed capital value" amounts during the 40 years to $161,800,000, the present value of which is $50,450,000. The net residual income left after taking out the 5 per cent prior return amounts to $129,200,000 during the 40 years. The present value of this is $32,810,000, the 45 per cent of which apportioned to the company amounts to $14,760,000. The present value of the $14,000,000 paid to the security holders out of the 3-per-cent-of-gross-receipts amortization fund at the end of 20 years is $3,880,000, and the present value of the three-fourths of the $131,000,000 cost of the investment at the end of 40 years, is $9,550,000 as before. These items added together make a total present value of all the resources for 40 years of $78,640,000.

Subtracting $61,250,000, the present value of the cost of the investment, we have $17,390,000 as the present franchise value to the United Railroads of the complete street car system for 40 years operated under the provisions of the proposed Charter Amendment No. 34 according to the "Resettlement Plan 5" as recommended by Mr. Arnold. The fact that this franchise value is practically identical with that arrived at for independent operation by the United Railroads under conditions of adequate service is purely adventitious and is not in the nature of a check on the estimate since the figure is reached from entirely different conditions.

By the operation of the street car system under a resettlement plan no investment would be required from the city, but it would receive an income of 55 per cent of the residual net income from operation. the present value of which for the 40 year period would amount to $18,050,000. The city would also receive the proceeds of the amortization fund during the second 20 year period which would amount to $34,301,000 at the end of 40 years. The present value of this amount is $3,330,000, which, added to the other income, makes the present franchise value of the city's share of the income under the resettlement plan $21,380,000 with no investment whatever.

The present values that have been mentioned are shown in the following tabulation. It must be carefully noted that the franchise values in all cases represent a fictitious investment at 6 per cent interest in addition to the real investment at 6 per cent interest shown in the previous column.

(To be continued.)

ELECTRIC PLANTS IN THE PHILIPPINES.

Zamboanga will be the first municipality to own an electric light and power plant in the Philippines. The Moro capital has been authorized to float a $100,000 bond issue for establishing the plant.

A bid offering 2 per cent of gross earnings for the government franchise authorizing an electric light, heat, and power company to establish a plant on the Agno River, has been submitted by the Agno River Mining & Power Company to the Executive Bureau at Manila. The bid is in accordance with act No. 2006, passed some time ago, which offers to grant to the highest bidder the right to establish an electric light, heat, and power plant on the Agno River, to supply the city of Baguio and the subprovince of Benguet. The act does not limit the business of the plant to this territory, however, and, if the bid is accepted, electric power and light may be furnished to the surrounding provinces.

RAPID INCREASE IN HYDROELECTRIC PLANTS IN JAPAN.

The number of hydroelectric power plants is increasing steadily and rapidly throughout Japan. The number of companies now engaged in furnishing power has reached 383 and they operate 620 waterpower batteries. The total horsepower developed at the present time is over 2,000,000. The following table shows the increase in hydroelectric companies, and also in the horsepower furnished, during the past 10 years:

Year.	Companies.	Horsepower.
1903	87	148,846
1904	93	238,633
1905	103	285,393
1906	180	1,168,993
1907	244	1,816,611
1908	262	1,872,348
1909	284	1,917,901
1910	321	2,005,438
1911	365	2,075,575
1912	383	2,172,891

STEEL TOWERS FOR OVERHEAD TRANSMISSION LINES

BY ALFRED STILL.
Member A. I. E. E., Inst. E. E.

Although details of design and the proportioning of parts are matters best left to the manufacturer, the general type of supporting structure to be used under given conditions should receive careful attention on the part of the transmission line engineer. The most economical design of tower to withstand the probable loads that it will be subject to, and to satisfy local conditions, including such considerations as transport and erection facilities, is a problem deserving close attention on the part of the engineer responsible for the design of the transmission line. A study of the probable loads to be resisted under the worst weather conditions will enable the designing engineer to specify certain test loads which will ensure that the finished structure will be strong enough to fulfill the practical requirements. The proper value of these test loads and their distribution or point of application should be determined only after mature consideration. The cost of a tower—apart from the height, which is a function of the length of span—is determined largely by the specifications of test loads. A specification calling for tests that are unnecessarily severe, is just as true an indication of incompetence on the part of the designing engineer as a specification giving test conditions that will result in a tower too weak for the actual requirements.

The calculation of stresses in the various members of so simple a structure as a transmission line tower is not a difficult matter, especially if graphical or semi-graphical methods are adopted. If the designing engineer will make sketches of two or three alternative designs likely to fulfill the required conditions, he should be able quickly to calculate the approximate value of the stress in the chief members, and so obtain a rough idea of the relative weights and costs of alternative designs. The danger of leaving the problem entirely in the hands of the manufacturer is that the latter is always tempted to put forward a design of which he has perhaps made a specialty, and which may have given entire satisfaction in practice without necessarily being the best type of structure for the purpose, or being entirely suitable for use under different conditions.

Stresses in Compression Members.

The failure of steel towers under excessive loads is usually due to buckling of one of the main leg angles in compression. There are many empirical formulas in use for determining the loads that struts or columns will withstand. Rankine's formula for determining the unit stress to be used in the calculations of compression members is,

$$\text{Unit stress} = \frac{\text{Load}}{\text{Area of section}} = \text{lb. per sq. in.}$$

of cross section of compression member

$$= \frac{T}{1 + \dfrac{l^2}{c\,r^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where T = maximum stress of steel in tension (or in short column in compression) expressed in lb. per sq. in.

l = length in inches of unsupported portion of compression member,

r = least radius of gyration, in inches,

$$= \sqrt{\frac{\text{moment of inertia.}}{\text{area of section.}}}$$

C = a constant.

For mild steel as generally used in tower construction, with an ultimate tensile strength of about 60,000 lb. per sq. in., a factor of safety of 3 (which is usual) would give 20,000 as a safe working stress. The value taken for T in formula (1) usually lies between 18,000 and 30,000. The figure decided upon appears to depend largely on the margin of safety included in the maximum load assumptions. For preliminary calculations the following numerical values are suggested:

T = 25,000.

C = 18,000.

The "straight line" formula, as suggested by Burr, is quite satisfactory provided the ratio $l \div r$ lies between 40 and 200; this last figure corresponds to a length of compression member not exceeding about twenty times the width of flange. This formula is:

$$T_c = T - k\,(l/r) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where T_c is the allowable stress in the compression member:

T is the unit stress in short columns.

k is a coefficient based on experimental results.

If the strut may be stressed to the elastic limit (about half the ultimate load), the formula can be written:

$$T_c = 26{,}000 - 90\ l/r \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

For a factor of safety of 3 and a working stress not exceeding 20,000 lb., the formula becomes:

$$T_c = 20{,}000 - 70\ l/r \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

It is recommended that l/r shall not exceed 100 for main members and 120 for lateral or secondary members. The fact that, for a given cross-sectional area, the shape of the section is an important factor in determining the stiffness and ultimate strength of the members in compression, suggests that, where lightness and economy of material are of great importance, the section of structural steel having the greatest moment of inertia per sq. in. of cross-section should be chosen. The standard sections of rolled angles or tees do not necessarily make the most satisfactory or economical struts or columns, and it is for this reason that tubular sections of steel are sometimes used in place of angle sections on transmission line towers. As an example of the relative economy of the tubular form and other forms of section, when used as comparatively long struts, a steel tube 7 in. internal diameter ⅛ in. thick, weighing 10 lb. per ft., will be as efficient in resisting compression as a steel angle 7½ x 7½ in. and ½ in. thick weighing 25 lb. per ft., or as an H beam 8 x 6 in. and ½ in. thick weighing 35 lb. per ft. So large a tube would not be required except in very high towers; a tube from 4 to

5 in. diameter would generally be large enough for the main members of a transmission line tower up to 100 ft. high. The illustration Fig. 1 is from a drawing kindly supplied by Messrs. Stewarts and Lloyds Ld. of Glasgow, Scotland; it represents a tower 146

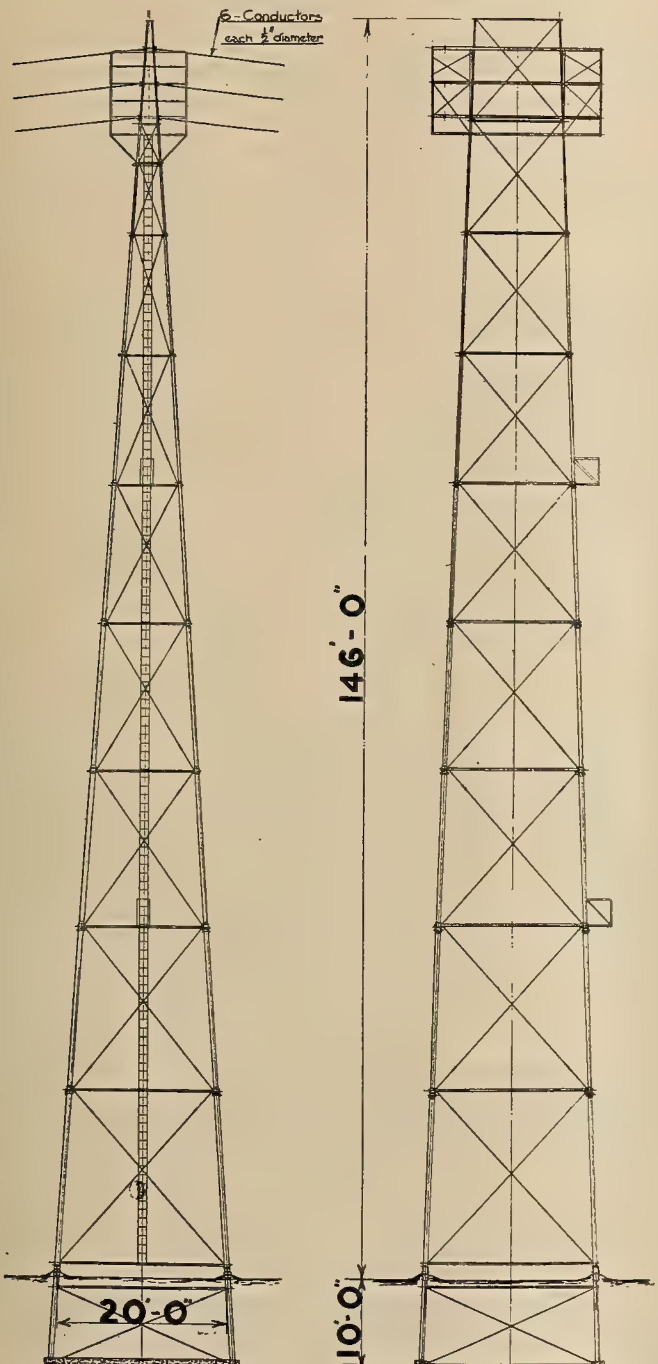


Fig. 1.

ft. high as supplied for a power transmission line in the South of England.

Outline of Usual Method for Calculating Stresses in Tower Members.

The illustration Fig. 2, which is reproduced by kind permission of the Shawinigan Water & Power Company and the Canadian Bridge Company, Ld., shows a typical square base galvanized steel tower as used on the Three Rivers line of the Shawinigan Water & Power Company of Montreal. These towers are designed to carry six aluminum conductors of nineteen strand 200,000 circular mil cable, each being supported by seven suspension disks of the Ohio Brass Company's standard type. In addition to the conductors there are two ground wires of ⅜ in. stranded Siemens Martin steel cable attached to the points (1) at each end of the upper cross arm. The line is built for 100,000 volts.

The method of procedure in calculating stresses is to make a sketch showing the points of application and the vertical and horizontal components of the outer forces. Then indicate by arrows the assumed horizontal and vertical components of the reactions, using the suffixes R and L to indicate the direction or assumed direction of the horizontal components. Since the whole structure is in equilibrium under the influence of the various loads and reactions, it is merely necessary to see that the three following conditions are satisfied at any point considered:

(a) The sum of all vertical force components = zero.

(b) The sum of all horizontal force components = zero.

(c) The sum of all moments about any point = zero.

When taking moments in any particular plane, all those in a clock-wise direction would be considered positive and those in a counter-clockwise direction negative. All joints are considered as frictionless pivots, which assumption is, of course, not strictly correct, especially in the case of riveted joints. It is usually an easy matter to choose a section through the structure in such a position that the stresses in a a given bar can readily be calculated by applying one or more of the three equations of equilibrium.

The sketch Fig. 3 will serve to illustrate the usual method of calculating the stresses in the main members of a tower structure such as the one shown in Fig. 2. The loading considered is that corresponding to the condition of test loads I and V applied simultaneously.

The point at which the horizontal breast pull of 12,000 lb. is applied corresponds approximately with the point 65 ft. above ground level where the corner legs would meet if produced beyond the points (13). The weight of the tower (which it is supposed has not yet been designed in detail) is taken at 4000 lb., and this, together with the test load V, gives a resultant vertical loading of 12,800 lb. applied somewhere on the centre line of the tower.

Consider a section such as X Y, which cuts only three members, namely the leg A at ground level, the leg B just above joint O^1, and the diagonal brace C.

Select a point O where the members A and C meet, and consider the moments, in the plane of the paper, which are produced round this point by the external forces and the reactions in the members severed by the imaginary section X Y. It is obvious that the stresses in A and C have no effect on the tendency of the part of the structure above the section line to rotate on the point O, and the whole of the externally applied turning moment must be resisted by the stress in the member B. Therefore

$(12{,}800 \times 5.75) + (12{,}000 \times 47.5) + (X \times 11.5) = 0$

from which it is found that X = 56,000 lb.

Since there are two members B taking the whole crushing stress, the total load tending to crush the one member B is 28,000 lb. The length of the unsupported portion of this member is 5.5 ft. or 66 in. The cross-section of 4 x 4 x ¼ in. angle is 1.93 sq. in.; and the least radius of gyration, r = 0.79. The test load should not strain the tower beyond the elastic limit. Using the formula (3), the allowable stress is:

$$T_c = 26{,}000 - 90 \times 66/.79$$
$$= 18{,}500.$$

This corner member is therefore capable of supporting without permanent deformation a compressive load of 1.93 × 18,500 = 35,700 lb. It should therefore be of ample strength to resist the test load of 28,000 lb.

Turning now to the uplifting force acting in the member A and tending to pull up the foundation, the centre from which the moments are calculated is shifted to the point O^1 where the members C and B meet. The equation of moments is now

$$(12{,}000 \times 65) + (128{,}000 \times 8) + (X \times 16) = 0$$
$$X = 42{,}300$$

and the tension in one corner angle A is 21,150 lb. The above example briefly describes what is known as the method of moments. It has been assumed that the side of tower considered lies in the same plane as the external forces; but the error introduced is practically negligible. If desired, it is an easy matter to make the necessary correction.

In calculating the stresses in a diagonal member such as C of Fig. 3, the moments would be taken round the point O^{11}, which is the junction of the members A and B; but in that case the actual loads on cross arms and the wind pressure on the side of the tower would have to be taken into account and substituted for the concentrated test load of 12,000 lb. at the point O^{11} which does not produce any stress in the brace C so long as the corner angle A remains truly straight and exerts no lateral pressure at the point O. The method of moments can usually be applied for all sections of a tower structure if the imaginary dividing planes are properly placed. The counter members or ties that are not in tension under the conditions of load considered are usually assumed to be non-existent, i.e. to serve no useful purpose as compression members.

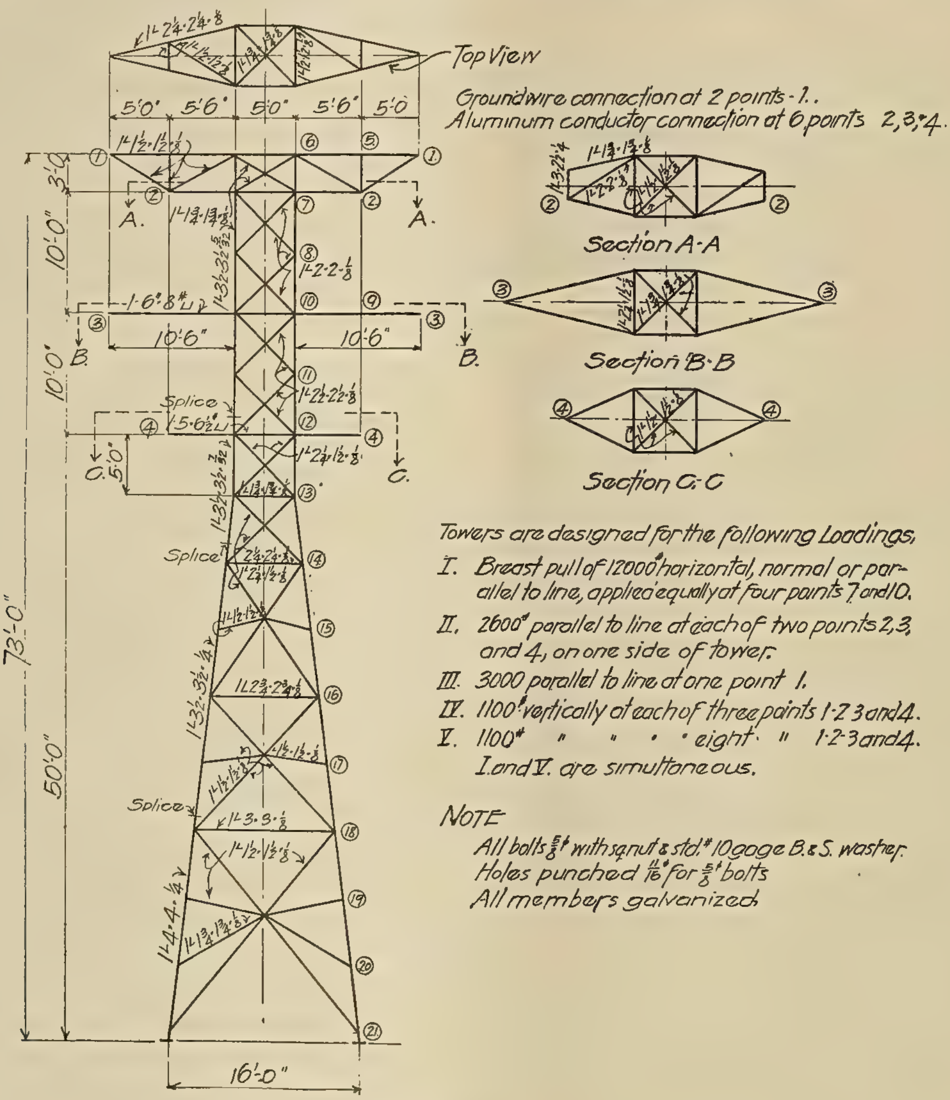


Fig. 2.

Foundations.

The upward pull on the tower legs, which was found in the above example to amount to 21,150 lb., has to be resisted by the foundation. A factor of safety of 2 is usually allowed. The weight of con-

crete may be taken at 140 lb. per cu. ft., and of good earth at 100 lb.; the volume of the earth to be lifted being calculated at the angle of repose, which may be about 30 or 33 degrees with the vertical, as indicated in Fig. 4. If the footing of a tower is in gravel or a

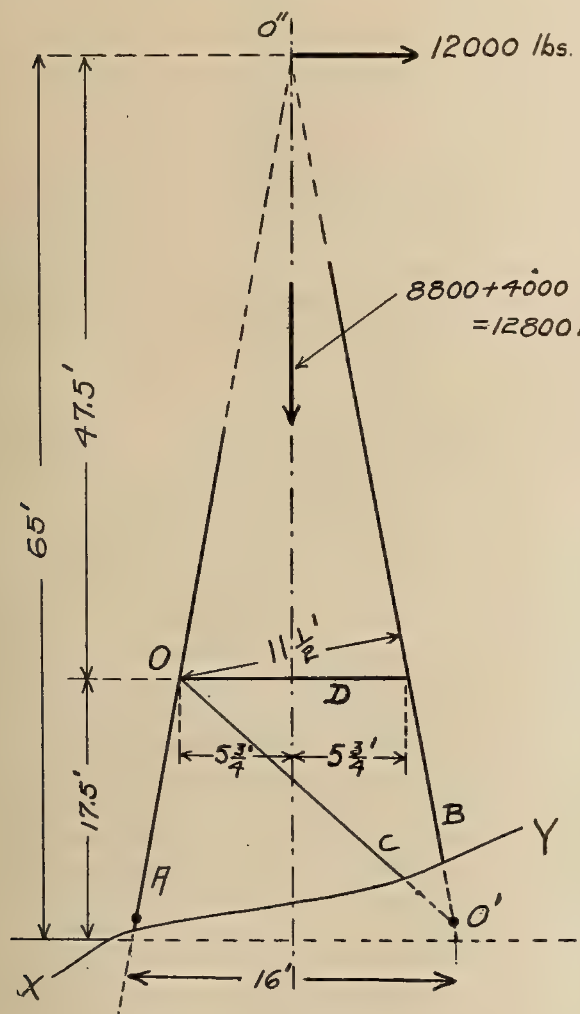


Fig. 3.

mixture of sand and loam tightly packed, there is actually a far greater resistance to the pulling up of the footings than that which is offered by the mere weight of the footings with prism of earth as calculated in the usual way.

When concrete has to be used, it is generally cheaper to reinforce it with steel of an inverted T form, as this makes a lighter construction than a solid block of concrete, and an equally good hold is obtained owing to the increased weight of the packed earth which has to be lifted. At the same time it must not be forgotten that the digging of a large hole five to eight feet deep is considerably more costly than the digging of a hole about two feet square, and this extra cost in erection must be taken account of in designing the footings. In marshy or loose soil or where the right of way is liable to be flooded, special attention should be paid to the design of durable foundations. Concrete footings, with or without piles, or rock-filled crib work may be necessary; it is a matter requiring sound judgment and preferably previous experience on the part of the engineer in charge of construction. Crumbling hillsides are best avoided; it is extremely difficult to guard against damage by land slides or even snow slides when towers are erected on the steep slopes of hills.

The use of concrete adds considerably to the cost of foundations and it should be avoided if possible; on the other hand, it is not easy to design foundations to resist a given uplift without an exact knowledge of the soil conditions at the site of the tower. For the greatest economy of foundation, it is necessary that the designer obtain reliable information on this point.

Assuming an average angle of slope of 30 degrees, as indicated in Fig. 4, and a weight of soil of 100 lb. per cu. ft., the depth of foundation may be calculated as follows:

Let h = depth of footing below ground level,
r = equivalent radius of footing area,
R = radius at ground level of conical section of earth to be lifted.
θ = angle of natural slope of earth.

The volume of frustrum of cone to be lifted is,

$$V = \frac{\pi}{3} h \; (r^2 + R^2 + r R) \quad \ldots\ldots (5)$$

or, if $r + h \tan \theta$ be put in the place of R,

$$V = \frac{\pi}{3} h \; (3 r^2 + h^2 \tan^2 \theta + 3 r h \tan \theta) \quad \ldots\ldots (6)$$

If θ = 30 degrees, $\tan \theta = 0.5774$ and (approximately),

$$V = \pi h \; (r^2 + .11 h^2 + .58 r h) \quad \ldots\ldots (7)$$

Try r = one foot, and h = seven feet; the volume of earth to be lifted, by formula (7) is then,

$V = 230$, which gives,
$W = 23{,}000$ lb.

As previously mentioned, if the soil is firm, this method of calculation usually gives results well below actual values of pull required to uplift the footing.

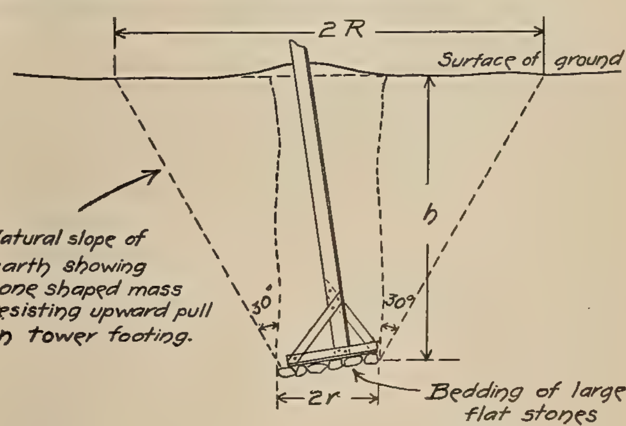


Fig. 4.

Under the conditions upon which this example has been based, it is probable that the footing would not move with a pull appreciably smaller than 30,000 lb.; there would then be a packing of the soil immediately above the footing, and a final pull of about 40,000 lb., might be necessary to uproot the stub and footing.

If the footings are imbedded in concrete, it is well to let the iron-work project through the bottom of the concrete block, to ensure that the tower is properly grounded.

Stiffness of Steel Towers—Deflection Under Load.

The deflection of the top of a transmission line tower of the ordinary light "windmill" type with wide square base, when bolted to rigid foundations and subjected to a horizontal load such as to stress the material to nearly the elastic limit, might be from two to five inches. With regard to the two-legged or "flexible" type of tower, if this is of uniform cross-section it can be treated as a beam fixed at one end and free at the other end. If the resultant pull can be considered as a single concentrated load of P lb. applied in a horizontal direction, at a point H in. above ground level, the deflection, in inches, will be

$$\delta = \frac{1}{3}\,\frac{PH^3}{MI} \qquad (8)$$

where M is the elastic modulus for steel (about 29,000,000; being the ratio of the stress in pounds per sq. in. to the extension per unit length), and I is the moment of inertia of the horizontal section of the tower.

Concluding Remarks Regarding Steel Tower Design.

Generally speaking there is a tendency to economize in the cost of steel towers by using sections of structural steel in which stiffness is obtained by making the thickness of metal small in proportion to the other dimensions of the cross-section. It is true that light weight of parts and of the complete tower are important if the advantage of lightness can be obtained without sacrifice of other advantages, the chief of which is durability. When a transmission line is not intended to last longer than 15 or 20 years, these light sections are allowable; but for the more important and costly lines, it is well to avoid the use of metal thinner than ¼ in. for the main members, or than 3/16 in. for the secondary or bracing members. In the writer's opinion it is not wise to use 4 x 4 in. angles for the corner legs less than 5/16 in. thick, although a thickness of ¼ in. is very common in towers actually in use at the present day. The ultimate life of such towers is, however, as yet unknown. Towers made of few peices of comparatively heavy section steel will probably prove more durable than those built of a larger number of lighter parts.

The above remarks concerning thickness of metal are not intended to apply to structures of which the members are of tubular section. If carefully designed and painted when necessary, the metal in tubular members could be considerably thinner than would be permissible with the usual sections of structural steel. In fact it would appear that the slenderness ratio l/r which is used in determining the allowable stress in columns or struts, is not entirely reliable in practice. A symmetrical section such as a tube or H beam, would seem to be more satisfactory than the more common angle section as used in the corner legs of towers.

When considering designs of towers for a long transmission line, special cases will generally arise, requiring special treatment. It is well to avoid if possible a number of different designs, and where the height does not require to be increased, it may sometimes be found more economical to use two standard towers close together for supporting special long spans, or for turning sharp corners, than to design special towers for the purpose. An angle not exceeding 7 degrees can usually be turned on a standard tower. This angle may even be as great as 10 degrees, especially if the length of the approach spans is decreased. In fact by reducing the length of approach spans, very much sharper angles can be turned; but it then becomes a question whether a special structure might not be cheaper. There is an unexplained prejudice against the guying of steel towers where extra strength to resist lateral loads is required. By giving proper attention to the method of guying, and inspecting the line at regular intervals, there is no apparent reason why this fairly obvious device to save the extra cost of special structures should not prove entirely satisfactory; it cannot, however, be expected to find favor with those whose particular business it is to make and sell transmission line towers.

ENTROPY-TEMPERATURE AND TRANSMISSION DIAGRAMS FOR AIR.

"Entropy-Temperature and Transmission Diagrams for Air," by Professor C. R. Richards, has just been issued as Bulletin No. 63 of the Engineering Experiment Station of the University of Illinois. This bulletin presents the theory and use of an entropy-temperature and an entropy-log temperature diagram, by the aid of which all problems pertaining to the expansion and compression of air may be solved graphically; and an air transmission diagram for determining graphically the size of pipe required to transmit a given quantity of air through a given distance with any assumed loss of pressure. The bulletin further discusses the conditions affecting the maximum power which may be transmitted through pipe lines carrying compressed air, and the general efficiencies of power and pressure transmission. Copies of Bulletin 68 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

WASTES OF NATURAL GAS.

The history of the natural gas industry of the United States is an appalling record of increditable waste according to Ralph Arnold and Frederick G. Clapp, authors of Technical Paper 38 of the United States Bureau of Mines on the subject, "Wastes in the Production and Utilization of Natural Gas and Means of Their Prevention." The waste of natural gas has drawn the attention of the entire country, and because the waste threatens the life of gas fields it has prevented many investors from building plants in the various fields, thereby depriving the localities of increased population and wealth. The most notorious waste at present is in Oklahoma, Louisiana and California. The commission on the conservation of the natural resources in Louisiana, after an exhaustive examination of the situation in the Caddo field, found that the waste approximated 75,000,000 cu. ft. per twenty-four hours, an amount equal to twenty times what the city of Shreveport uses now in the same space of time and equal to one-twentieth of the amount consumed by the entire United States.

ELECTRICAL PUMPING AND IRRIGATION

REINFORCED CONCRETE PIPE.

BY B. A. ETCHEVERRY.

On the Roswell project, Idaho, the reinforced pipe was the dry mixture, hand-tamped pipe, described further, around which was wound the reinforcing steel wire, which was covered with a rich cement mortar. The method of winding the wire, applying the plaster and laying the pipe is described as follows by Zenas N. Vaughn, the engineer in charge:

"Two movable bulkheads, with crank handles attached, are so arranged that the pipe length can be firmly clamped between them. At a distance back of this device a steel shaft, into which is cut a screw groove, works freely horizontally. Back of this, and horizontal to it, a wooden shaft is placed for regulating the tension of the wire, and still back of this is a vertical spindle, from which wire unwinds automatically. The wire used for reinforcing is a No. 12 gauge, galvanized wire, having a tensile strength between 500 and 600 pounds. A coil of this is placed vertically upon the spindle, the wire is passed around the tension shaft, thence into the screw groove, and is finally firmly attached to one end of the pipe length by soldering. The pipe is then revolved by two men at the crank handle, by which process the wire is wound upon the pipe under a high tension, the spacing of the laps of the wire being made even by the screw groove. Variation in spacing for different heads is accomplished by using pulleys of different diameters, to govern the rate of revolution of the grooved shaft as compared with that of the pipe length. The reinforcing is stressed the same as that in the main pipe.

"When the reinforcing reaches the end of the pipe length, the last two or three laps being made parallel, it is again soldered, and the wire is severed. A steel trowel curved to conform to the shape of the pipe, and suspended above it, is then dropped into place, and cement mortar, 1½ to 1, is run upon the pipe as it revolves, the trowel smoothing this down to a uniform thickness. The bulkheads are then unclamped by a lever at one side, the pipe is removed, and is carried away to be properly cured.

"In the trench the bell and spigot ends of the pipe are fitted together, as in the case of sewer pipe. Around the joint is placed a flexible form, made of very heavy canvas, attached to blocks of wood, sawed out in such a way that a space of about one inch, measured transversely to the pipe, and six inches longitudinally, is left vacant for the reception of the mortar. Along each edge of the form is run a 12-gauge wire, terminating at one end in an iron ring, at the other in a tongue pin, curved in shape, so that when clamped through the ring it draws the wire to a high tension, firmly binding the form to the pipe. The form is then filled with cement mortar, and immediately afterwards the interior of the joint is carefully pointed to insure water tightness, independently of the collar, as far as practicable. As soon as the collar forms can be removed, the trench is backfilled, to protect the collars while curing." (Journal of Idaho Society of Engineers, pp. 40-41, Vol. I.)

In Southern California reinforced pipe built in the same manner has been used. It is wound with No. 12 galvanized wire, spaced about 1½ inches apart, and coated over to protect the wire from corrosion. The cost of reinforcing the hand-tamped pipe is 10 cents per foot for 10-in. pipe, 15 cents for 12-in. pipe, 25 cents for 20-in. pipe, and 35 cents for 26-in. pipe.

Cost of Making and Laying Reinforced Concrete Pipe.

Umatilla Project.—A distinctive feature of the Umatilla project is the irregular topography of the irrigated land, which has required the use on many of the laterals of several miles of reinforced concrete pipe to carry the water over depressions. The pipes have been made in two sizes, 46 in. and 30 in. in internal diameter. The 46-in. pipes are 3 in. thick and made in sections eight feet long. The 30-in. pipes are 3 in. thick and the sections four feet long. The larger size pipes were made at first 47 in. in diameter and only 2½ in. thick. The M line siphon described farther was made of this 47 in. pipe.

The reinforcement consists of a steel wire wound in a spiral made rigid with seven longitudinal rods and cross-laced with small wire, No. 16. The reinforcement is made of different weights, according to pressure. For pressures above 30 ft. up to a maximum of 55 ft. large size pipe is reinforced with 5/16-in. wire, spaced 2½ in. apart. This reinforcement weighs 33 lbs. per lineal foot of pipe; the lighter reinforcement weighs 9 lbs. per lineal ft., and the light reinforcement 7 lbs. per lineal ft. The reinforcement, including labor making the spiral, cost 4½ cents per lb. for the 47-in. pipe and 5½c per lb. for the 30-in. pipe.

The concrete was composed of 1 part cement to 2.3 parts of sand and 3.0 parts of gravel, screened through 1-in. mesh, and rejected on ¼-in. screen. Cement cost $2.25 a barrel, sand $1.00 a cubic yard, gravel $2.65 a cubic yard. The cost of various pipe lines made on this project was:

Line	Inside diameter.	Length.	Maximum head.	Cost of pipe.	Total cost laid, including hauling trench excavation. etc.	Cost of placing and making joints, including material.
R_1	46	9831	110	2.97	4.43	.59
O_1	46	5312	36	2.24	3.86	.48
R_2	46	1284	15	2.24	3.26	
D_1	30	5330	45	1.26	2.25	
O_2	30	3556	26	1.26	2.45	
R_3	30	3645	25	1.26	2.04	.22
R_4	30	1622	18	1.26	1.96	

The following approximate prices, which include the material, the making and laying, but not the excavation of trench and the backfilling, are now prevalent in Southern California:

Diameter. in inches.	Cost in dollars for 25-ft. head.	50-ft. head.	100-ft. head.
24	1.75	2.00	2.30
30	2.25	2.50	3.00
36	2.65	3.10	3.60
42	3.20	3.65	4.25
48	3.85	4.40	5.10

The present prices in Southern California for reinforced pipe made with hand-tamped pipe wound with wire and plastered with mortar, are as follows: (These prices are for pipe laid.)

Diameter of pipe.	Cost per lineal foot.	Diameter of pipe.	Cost per lineal foot.
6-in.	$0.20	14-in.	$0.75
8-in.	.30	20-in.	1.20
10-in.	.40	26-in.	2.00
12-in.	.60		

Advantage and Economy of Reinforced Concrete Pipe.

The great advantage of reinforced pipe is its durability. The first cost, as compared to wooden pipe, is usually a little greater, but its longer life will make its ultimate cost much lower, especially when the pipe cannot be kept constantly full. It has been shown that for a wooden pipe, whose life is ten to fifteen years, the total annual cost to pay interest on first cost, renewal and depreciation, is 15 per cent of the first cost, and for a wooden pipe whose life is 20 to 30 years, about 11 per cent. For a concrete pipe, depreciation and renewal are practically eliminated; therefore interest only, at about 6 per cent, need be considered. Based on these figures, a concrete pipe would be as economical in cost as a wooden pipe, even when the concrete pipe cost about twice as much as the wooden one. The prices of wire-wound wood pipe, good for 50 to 100 ft. head, are about as follows for the Northwest States, where large quantities are used and the prices low:

Diameter of pipe.	Cost per lineal foot.	Diameter of pipe.	Cost per lineal foot.
6-in.	$0.23	16-in.	$0.80
8-in.	.38	18-in.	.95
10-in.	.52	20-in.	1.25
12-in.	.57	22-in.	1.45
14-in.	.64	24-in.	1.60

The prices for wooden stave pipe for 50-ft. head, built in place, are about as follows:

Diameter of pipe.	Cost per lineal foot.	Diameter of pipe.	Cost per lineal foot.
26-in.	$1.80	42-in.	$2.80
28-in.	2.00	48-in.	3.40
30-in.	2.20	54-in.	3.90

For 100-ft. head the prices would be about 25 per cent higher.

Comparing the above prices with those for reinforced concrete pipe, it is seen that there is no great difference in first cost, but if ultimate cost is considered, the economy is in favor of reinforced concrete pipe. However, the use of reinforced concrete pipe is limited to moderate heads, under 100 to 150 ft., and they require careful workmanship and an expensive manufacturing plant. Wooden stave pipes have the advantage that they can be used for higher heads and that they are easily and quickly put together. The carrying capacity of wooden stave pipes is greater than that of concrete or steel pipes of the same diameter.

An approximate comparative cost of steel, wood and reinforced concrete pipe is given below. The steel pipe, which has a minimum thickness of ¼ in., will stand a pressure head of 161 ft. The wooden stave and reinforced concrete pipe will stand a head of 100 ft. The prices for wooden stave and steel pipes are approximate San Francisco prices, no allowance has been made for railroad transportation. The prices include materials, making, laying and joining, but not excavation and hauling.

	Safe head.	Cost.
48-in. reinforced concrete pipe	100	$5.10
46-in. reinforced concrete pipe on Umatilla project, Oregon	110	3.60
48-in. wooden stave pipe	100	4.61
48-in. riveted steel pipe	161	9.00

With concrete pipes it is very necessary to prevent the accumulation of air in the pipe to avoid water hammer. This requires that air valves of ample capacity be placed wherever air will collect in the pipe.

The experience of European constructors indicates that while reinforced concrete pipes are more or less porous and subject to percolation under moderate heads when first constructed, the percolation rapidly diminishes and the pipe becomes water tight. This is well illustrated by the following examples.

Tests of Water Tightness of Reinforced Concrete Pipe.

The Reclamation Service has made tests to determine the impermeability of the reinforced concrete pipe made on the Umatilla project, Oregon. The pipe tested was made of two sections cast in moulds as described above. The pipe was 46 in. in internal diameter and 3 in. thick, reinforced with a double coil of 5/16 in. wire with 1½ in. spacing which is approximately equivalent to a single coil of 15/32 in. wire with 1½ in. spacing. The concrete was composed of 1 part of cement to 1.44 sand and 2 of gravel. To make the tests the sections were joined and bulkheads placed at the two ends. Two types of joint were used. One consisted of a collar case in three pieces, each a little smaller than 1/3 the circumference, and placed around the pipe, then joined and cemented to the pipe. The other form of joint consists of a collar cast in place around the pipe. The results obtained by collecting and measuring the seepage water and reducing the measurements to an equivalent loss per mile were as follows:

1. With joint made of collar built up of three segments: A pressure of 47 pounds per sq. in. caused an average seepage equivalent to .24 cu. ft. per second for one mile of pipe. Pressures of 48 to 50 pounds caused a seepage equivalent to .31 cu. ft. per second for one mile of pipe.

2. With collars cast in place: A pressure of 40 pounds per sq. in. gave an equivalent average seepage of .12 cu. ft. per second per mile. A pressure of 50 pounds gave .42 cu. ft. per second and a pressure of 55 pounds gave .56 cu. ft. per second per mile.

The tension in the steel, assuming that the steel takes all the stress is:

Water pressure lbs. per sq. in.	Head in feet.	Tension in lbs. per sq. in.
40	92	9,000
45	103	10,125
50	115	11,250
55	127	12,375

These tests show that properly made reinforced concrete pipes are practically watertight for pressures as great as 100 ft. head. The tests led to the adoption of reinforced concrete for a pressure pipe 46 in. in diameter, 3 in. thick, 9216 ft. long, under a maximum head of 110. The pipe was completed in January, 1910, and has been entirely successful.

Pressure Pipe for the Aqueduct of Acheres.

This pipe which is part of a conduit used to carry the sewage water of Paris towards the agricultural gardens of Acheres was constructed between 1892

and 1895. Where the pressure is above 72 ft. steel pipe was used; below 72 ft. the pipe is built of reinforced concrete by the Bonna system. From 72 ft. to 50 ft. the pipe is lined on the interior with a steel shell .177 in. thick. From 45 to 50 ft. the steel shell is .137 in. thick and below 45 ft. the pipe has no lining of steel. The length of the reinforced pipe is 4920 ft. and was built of sections 8.20 ft. long and 5.90 ft. in diameter and 4 in. thick, joined with reinforced collars. The concrete used consisted of about 1 part of cement to 2 of sand. The cement was a mixture of quick setting cement with slower setting cement. When the water was first turned in it was found that where the pressure did not exceed 26 ft. the pipe remained dry; for pressures from 26 ft. to 41 ft. there was a little sweating which stopped completely at the end of two months; and for pressures from 41 ft. to 45 ft. the sweating stopped at the end of three months. The price paid for the pipe in place was about $12 a foot for the unlined pipe and $18 a foot for the lined pipe.

The distributing system is about 21 miles long and all pipes are of the Bonna type. The diameters vary from 11.8 in. to 43.8 in., all designed to resist a water pressure of 131 ft. The reinforcement consists of a steel shell .23 in. thick between two reinforced steel skeletons, the whole being imbedded in a concrete shell from 1.37 in. to 2.75 in. thick. The prices paid for the pipes in place were: $4.60 to $5.50 per foot for 43.8 in. pipe, and $.72 to $.85 per foot for 11.8 in. pipe.

The strength of this type of pipe was proved in 1893 when M. Launay, Chief Engineer of Sanitary Works for the Department of Seine, France, tested a pipe 20 in. in diameter and 1.37 in. thick, reinforced with Bonna's reinforcement and a steel lining .04 in. thick. The pipe was designed for a maximum pressure of 66 ft. with a maximum tension in the steel of 11,400 pounds per sq. in. When tested it was submitted to a pressure of 409 ft. without rupture. After the test the pipe was cut open and showed that the pipe remained intact, the adherence between concrete and reinforcement being perfect.

Venice Pressure Pipe (Italy).

This conduit was constructed by M. Bordenave for the Water Company of Venice in 1890. The total length is 4.05 miles, the diameter is 2.625 (31½) and 1.46 in. thick for a head of 23 ft. This pipe has not required any repairs since it was put in. The loss of water by percolation which was at first 195 liters per minute, decreased to 102 liters per minute the fifth day, 71 liters the ninth day, and 8.66 liters in 115 days.

Mery, Pierrelaye and Triel Pressure Pipes.

These pipes are used for the distribution system of the above districts near Paris, and have a total length of 74.6 miles. The diameters of the pipes in inches are 78.75, 43.3, 39.4, 31.5, 23.6, 19.7, 15.75, 11.81. M. Bonna completed the work in eight months, the mean progress being 1640 ft. per day.

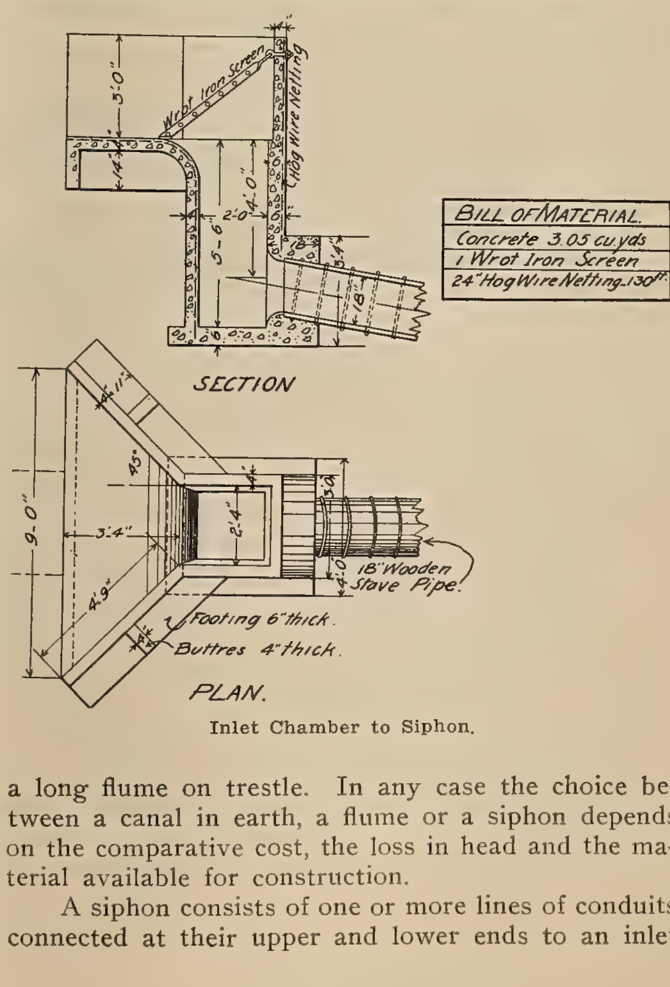
Bone Pressure Pipe (Algeria).

This pressure pipe was constructed by M. Bordenave for the city of Bona, Algeria, in 1893 and in 1895-1896. The total length is 19¾ miles. The diameter is 1.97 ft. and the pipe is under pressure heads of 28 to 79 ft. The reinforcement in both directions consists of steel I bars of the Bordenave type having a cross section of .042 sq. in. and a weight of .142 lbs., with a safe stress of 19.196 lbs., per sq. in. For a pressure of 49 ft. the thickness of pipe is 1.5748 in. and the spiral bars are spaced 3.21 in. apart. For a pressure of 82 ft. the thickness of the pipe is increased to 1.77 and the spacing is changed to 1.91 in. In both cases the longitudinal rods are 3.38 in. apart.

For large size conduits under pressure and especially for those above 5 or 6 ft. in diameter, it is usually more economical to build the pipe in place. While large size reinforced concrete conduits have been used extensively for sewers where the internal pressure is small, their use for irrigation work unless water is very valuable is limited to siphons. It is only in the last few years that such conduits have been constructed. The Reclamation Service has constructed a number of reinforced concrete siphons on many of its projects. On one of them, the Belle Fourche project three large siphons have been constructed. Other notable examples of large size pressure conduits are: (1) Siphon on the River Sesa and Canyon of Ribabona, Spain; (2) Siphon of Albelda, Spain; (3) Clay Creek Siphon. These pressure pipes are described under the subject of siphons.

Inverted Siphons.

Where an irrigation canal is to cross a valley or a natural drainage line the canal must either be run on a contour and the ravine or stream crossed by means of a flume or the depression must be crossed with an inverted siphon. For a long valley or depression a siphon may be much more economical than either a canal following the contours of the ground or



Inlet Chamber to Siphon.

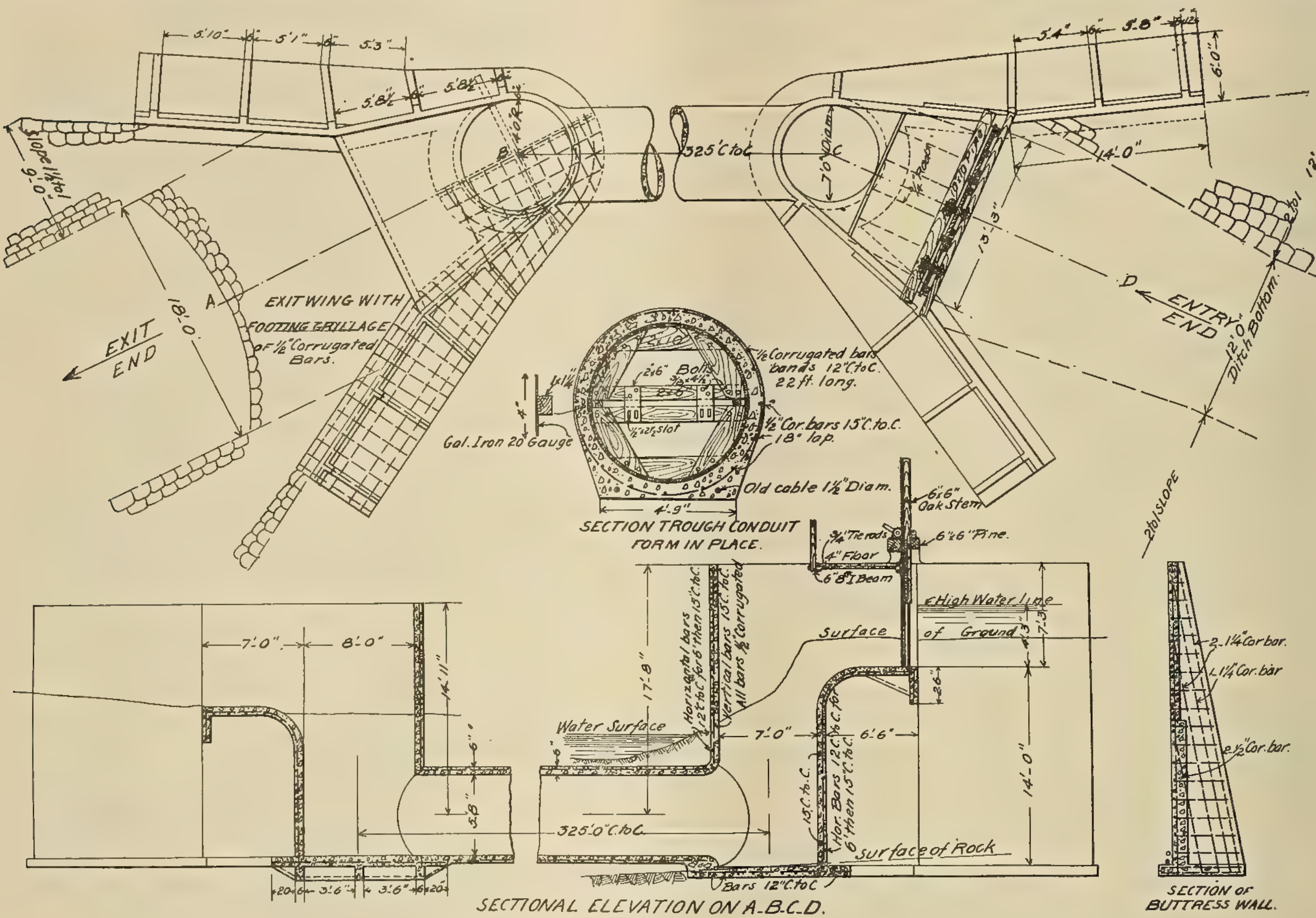
a long flume on trestle. In any case the choice between a canal in earth, a flume or a siphon depends on the comparative cost, the loss in head and the material available for construction.

A siphon consists of one or more lines of conduits connected at their upper and lower ends to an inlet

and outlet. Other accessories to a siphon are: Sand box and wasteway at inlet to permit the discharge of water in case of necessary repairs or break below and to remove heavier sand or gravel. Anchorage or collars used at elbows or bends. Air outlet valves at the convex bends and the high places to permit the escape of air collecting at the bends and summits. Air inlet valves at the summits to permit the entrance of air when emptying the siphon conduit. Blow off valves or discharge gates in the depressions to empty the siphon and in some cases to flush out silt or other material which may collect in the conduit.

The outlet should be designed to diminish the velocity of exit of the water and prevent scouring of the canal below. This may best be obtained by giving the outlet the same form as the inlet and discharging the water at the bottom of a well or by forming a funnel shaped outlet. In either case the water in the outlet above the conduit end forms a cushion and the velocity of exit decreases as it passes from the smaller conduit section to the larger cross section of the outlet basin or well.

One line of pipe or conduit is generally used. For large siphons it may be more economical to use two



Typical Inverted Siphon Construction.

The inlet should be designed to prevent the entrance of air and floating bodies in the conduit. This is best obtained by placing the end of the conduit well below the water level in the canal. This will keep the larger part of the floating material above the top of the conduit. The larger transported material can also be prevented from entering by using a screen. Gravel and sand may be kept out by providing a sand box and wasteway above the intake. It is only necessary to remove the heavier material for the velocity in the siphon is usually higher than that in the canal. To prevent the loss of velocity head due to entrance the connection with the conduit should be flared. The inlet will consist of the circular or rectangular inlet well and the transition from the canal which may be made with vertical or warped wings. For a wooden stave pipe the inlet is usually made as a rectangular wooden wall.

or more lines. The advantage of several lines is that a break or obstruction in one line will not mean a total interruption in flow. When even a partial interruption of flow would be disastrous, additional parallel lines may be necessary. This is seldom warranted for irrigation systems. To decrease the cost of the conduit the velocity must be made as high as the available fall will permit but not greater than the maximum velocity which the material of the pipe will stand. The pipe is made of steel, wood or reinforced concrete as described above.

GAS APPLIANCES IN JAPAN.

There are about a dozen gas mantle and other fixture manufacturing concerns in Tokyo and three or four in Osaka. The supply of wood for fuel purposes in the densely populated sections of Japan is quite scarce, and gas for heating purposes is becoming more popular.

REPORT OF N. E. L. A. CONVENTION.

General Sessions.

The thirty-sixth annual convention of the National Electric Light Association opened on June 2d with a registration of 3500 members. In many particulars it was the most important convention of the association yet held, especially in the matter of public policy declarations.

The convention and exhibit hall was formally opened in the Medinah Temple on Monday evening with a reception and ball, but the real work of the convention did not start until Tuesday morning, with the first general session, when Hon. L. E. McGann, commissioner of public works of the city of Chicago made an address of welcome to the delegates.

This was followed by President Tait's annual address, in which he reviewed the undertakings of the past year. He stated that the membership is now 12,442, spoke of the harmonizing work of the public policy committee and gave the details of the work of the several sections, committees and officers. He reiterated the suggestion that there should be four vice-presidents to divide the responsibility, recommended a national technical section and recommended a plan to increase the association's income. With regard to rebuilding properties destroyed by great disasters, he expressed the hope that companies will be permitted to refund the expense from the capital account, rather than be compelled to pay it out of surplus or earnings account. He dwelt on the steady decrease in rates, the better co-operation in all branches of the industry and the work of the committee on resuscitation. He concluded his talk with reference to the benefits of consolidating companies and the stability of electric light and power securities.

Secretary T. C. Martin read a telegram from John A. Britton, of the Pacific Gas & Electric Company and a member of the executive committee, in which the Pacific Gas & Electric Company tendered its greetings to the convention and expressed its regrets, owing to conditions, in not being able to have representatives present. It was tacitly implied that the 1915 meeting of the association would be held at San Francisco.

The report of the committee on the organization of the industry showed that the association has 1093 Class A members and 42 company sections.

Secretary Martin's report gave statistics of the detail work handled by the New York office, more than half the $100,000 income being expended in publications. During the past year the association has brought out a new form of statistical report on the subject of rates for municipal commercial lighting, power, heating, etc., and with the co-operation of one of the Class D members a census has also been taken on underground conduit installations.

Mr. W. H. Blood Jr. of Boston, insurance expert for the association, in his report stated that during the year the industry has been comparatively free from annoyance from litigation brought by insurance companies against lighting companies. This is on account of better construction and more careful housekeeping on the part of lighting companies, and also because insurance companies realize the importance and solidarity of the national association. Reductions in rates have been effected, due to the work of the insurance expert and also to the better showing made by lighting companies in the way of fire losses. Mr. Blood reviewed briefly the changes in the National Electrical Code, which were enacted at the meeting held in New York last March, and recommended the employment of inspection bureaus to look over the properties of the lighting companies, both from a fire-hazard and accident standpoint.

The report on progress presented by Secretary Martin dealt with the general conditions of the industry, and its relation to the public. Among these are the questions of conservation; the extension of Public Service Commission regulation; the nature of decisions affecting the industry as to rates and character of service; the advance in engineering in the generating plants; the use in different fields; the development of new fields of activity, as in electric vehicles, ice and refrigeration. Special attention was given to the question of electricity on the farm. A large part of the report was devoted to the relations between the companies and their employes; and many items were noted in regard to educational work, training of salesmen, the development of ideas in welfare work. Another extensive section of the report dealt with the illuminants of the day, discussed their progress, and cited numerous examples of modern practice, particularly with regard to street lighting. Another part of this report, dealing more specifically with questions of power transmission, was presened separately before the Hydroelectric and Transmission Section.

Paul Lupke's paper on "Anticipation" said that the lad who left school because he wanted to fire a boiler and objected to a course which contained too much of the "Lady of the Lake" compressed a large and difficult problem into a few words and little realized that his chances of eventually owning the boiler, instead of being obliged to shovel coal into it indefinitely, would have been materially increased if he had appreciated what a little more schooling would have meant to him.

"Central Station Power in Coal Mines" was the subject of a paper by W. A. Thomas, in which he gave an analysis of the costs in an average isolated plant supplying electricity for mine service, and showed the general character of mining loads and the probable requirements on a tonnage output basis.

"Switching Apparatus for Rural Installations," by E. B. Merriam, stated that recent outdoor switching apparatus has opened to central stations a wide field of application for their service in small towns, mines, quarries, farms, etc., which heretofore had to rely on isolated plants or manual labor.

"Central Stations in Small Towns," by Mr. J. E. Kearns, suggested a method whereby some of the present unprofitable plants may be operated more economically. The scheme in the main is to consolidate several small stations and to distribute energy from one main central station through substations containing modern apparatus.

The report of the public policy committee was presented in open meeting on Wednesday night and as it was signed by the most influential men in the industry, representing an investment of a billion and a quarter dollars it is the most significant of all reports presented. An electrical corporation giving good service at fair prices should be protected against destructive competition in their territory. The committee urges the care of employes as a definite responsibility. Every means should be provided for safety and sanitation. The company should see that the workman gets proper accident compensation. Important rate decisions of the past year are discussed. The committee is ready to advise companies meeting problems of municipal ownership. The proposed New York State hydroelectric development is perhaps the most serious and destructive activity of the moment.

The committee was instrumental in having this bill vetoed by the governor, who advocated the appointment of a commission to investigate the subject. The committee commends the recent movement which has resulted in the organization of commercial educational courses.

In conclusion, our committee recognizes the serious state of public unrest, here and abroad. To a large extent this is of a Socialistic nature. Probably no immaterial part results from the efforts of prosperous agitators who make a business of creating unrest amongst the industrial classes. Much good will be accomplished in continuing our policy of the past in approaching these problems in a spirit of earnest interest, fair

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Editor's Note:—The following report, supplementing that in our last issue, gives abstracts of reports and papers and also includes other interesting details of the N. E. L. A. convention just passed.

play, mutual good will and sincere regard for those associated with us in the conduct of our industry—all with a determination to render unto others that which we would have others render unto us.

The committee on resuscitation from electric shock questioned the claims made for the Pulmotor as an efficient mechanism for reviving unconscious subjects and outlined the mechanical method of artificial respiration by pharyngeal insufflation as developed by Dr. S. J. Meltzer.

At the concluding session of Friday, President Tait in the chair, the amendments to the constitution proposed by the committee, of which Mr. F. W. Frueauff is chairman, were adopted. These provide for foreign members and for four vice-presidents. The report of the nominating committee was presented by Mr. Samuel Insul, which was adopted unanimously and as the result these officers were elected: President J. B. McCall, Philadelphia; vice-president, John A. Britton, San Francisco; H. H. Scott, New York; E. W. Lloyd, Chicago, and E. C. Deal, Augusta, Ga; Treasurer, W. F. Wells, Brooklyn; members of the executive committee for three years: W. C. L. Eglin, Philadelphia; W. N. Ryerson, Duluth; R. S. Orr, Pittsburgh; member of executive committee for two years: Mr. H. C. Abell, Madison, Wis.; member of executive committee for one year: A. C. Einstein, St. Louis.

Mr. Insul escorted President McCall to the chair amid applause. Mr. Tait invested Mr. McCall with the gold badge of office and at the same time a basket of roses from employes of the Philadelphia Electric Company, was handed up to the platform as a tribute to Mr. McCall. The new president spoke briefly and noted the recognition of the younger element in the organization in the new administration.

Mr. W. F. Wells made the report from the committee on the award of the Doherty gold medal for the best paper presented before a company session during the year. This distinction was awarded to Mr. T. E. Bloodworth of the New York's section. Second prize, the Harriet Billings silver medal, went to Mr. Fred Willeby of Denver, and the third, $25 in cash, presented by Mr. Arthur Williams to Mr. A. D. Bailey of the Commonwealth Edison Section in Section.

Technical Sessions.

The report of the meter committee recommended the establishment of a standard dial-face for watthour meters, and discussed the effect of using induction watthour meters on frequencies other than those for which they were designed. The committee concludes that the error accompanying the measurement of energy consumed by flashing signs, welding machines, etc., is so slight as to be practically negligible, falling under 1.5 per cent except in extreme cases. The committee advocated the use of more uniform connection diagrams for instrument transformers. The report also contained descriptions of the latest meter developments and tabular information for the future revision of the "Electrical Metermen's Handbook," 25 to 35-cycle instruments being considered.

A paper on **"The Incandescent Lamp and Its Relation to Lighting Service,"** by R. E. Campbell and W. C. Cooper, discussed voltage drop in interior wiring installations, citing a large number of tests taken at random in various parts of the country, which showed the need of greater attention to the problems of wiring desired in relation to the more extended use of energy-consuming devices.

The committee on overhead line construction presented a report containing full specifications for overhead crossings of electric light and power lines and signaling circuits involving protection against potentials of 5000 volts and over. Valuable material is included regarding sags, factors of safety in line construction, conductors, insulators, poles, foundations, galvanizing, properties of the wire and other data of engineering interest. D. F. McGee, Portland, Ore., cited the difference in local conditions in the northwest and said that it would not be commercially feasible to carry specifications into effect in his territory. Other speakers viewed the material as of great value but chiefly as a working guide.

Commercial Session.

The first commercial session of the convention was called to order in the main auditorium, Tuesday afternoon, by President Tait who introduced Vice-chairman E. W. Lloyd, Chicago. The latter in his official address spoke with satisfaction of the recent work of the Commercial Section, now in its third year, and complimented the various committees on the concrete evidence of results accomplished in the way of publications, co-operative advertising, etc. The work of the committees on "Electricity on the Farm" and the wiring of existing buildings was commented upon. The latter committee has before it a problem difficult of solution in some localities and there is no subject that should receive greater consideration at the hands of electric service companies, manufacturers, dealers and contractors.

In relation to off-peak business, the subject of using electricity for refrigeration was considered. The load factor of this class of business is 50 per cent or greater, averaging 75 per cent for the months from April to October. The encouragement of the electric vehicle business was heartily commended. Many central station companies are not alive to the magnitude of this opportunity.

The finance committee reported total revenues of $5241 received during the past year, divided between the sources of dues and sale of publications. In all $4755 was expended, leaving with the surplus already on hand, a balance of $502.87.

The membership committee reported a present enrollment of 1222 active members. A scheme of organization with state captains is also to be attempted in making a more concentrated membership campaign during the coming year.

"How to Protect Business from Disturbanoes Caused by Panics" was the subject of a masterly address by David R. Forgan, president of the National City Bank. He prefaced his remarks by demonstrating the mutual interdependency of all modern businesses and the ramifications of the credit system throughout them. He clearly explained how dependent all business is upon credit, showing that except for gold coin all securities, currency and money is simply credit, a promise to pay.

After discussing the disadvantages of the present American banking system and reviewing the recommendations of the National Monetary Commission he showed that the four essentials in bringing our banking system up to date and in providing safeguards against financial stringency are (1) an elastic currency, (2) mobility of reserves, (3) liquidity of bank assets, and (4) the centralization of banking power closely allied to the national government.

The speaker endorsed the proposed National Reserve Association of the United States, which is to be formed through the united action of all the state and national banks of the country which care to come in and can qualify for membership. This great bank will also be the fiscal agent of the government, having possibly three hundred millions of capital, holding the reserves of the banks and having large power in issuing notes redeemable in the national money. As a great central reservoir of reserves it will act as a powerful agency against monetary stringency, and if established along the general lines recommended by the commission will go far toward making panics in the United States as rare as they are in England, France and Germany, where a centralized banking organization, closely allied to the government insures stability and confidence throughout the nation.

Mr. Forgan contended that there is little to fear in such a cenralization and that the assertion that by this scheme Wall Street is seeking to control all the money in the country is beside the mark. The truth is that it is proposed to transfer the control from Wall Street to Washington, from the hands of the private banks to the hands of all the char-

tered banks of the country, with the closest governmental relations. Closing, the speaker urged the united support of business men on behalf of the proposed reform, which will put this country on a level with its largest competitors in this great matter of national and international credit.

The report of the publications committee showed that 187,000 publications had been distributed during the past year, including issues of pamphlets on domestic lighting and service, industrial lighting, street illumination, etc. Of 1300 Class A members in the association, however, only 80, or barely 6 per cent, have taken advantage of the committee's work by ordering these publications for distribution in their own sales campaigns.

The report of the Electric Salesman's Handbook Committee, presented a collection of loose-leaf data. Some 338 compilations of data were prepared during the year just closed, in addition to 64 abstracts; making in all 681 compilations on 175 different industries.

The report on "Education of Electrical Salesmen" discussed in detail the requirements of the successful electrical salesman, which it enumerated as: (1) Thorough knowledge of the customer's problems and how to solve them, (2) good health, (3) enthusiasm, (4) courage, with modesty, (5) imagination, (6) strict regard for the truth, with a reputation for frank, honest dealing, (7) sales temperament, (8) ingenuity, (9) good manners, (10) strict regard for personal appearance, (11) unfailing good humor, affability, pleasing address, adaptation to circumstances, and an intuitive consciousness where perseverance ceases to be a virtue and becomes a nuisance. Descriptions of the courses of training given prospective salesmen by the Chicago Central Station Institute, the New York Edison Company and the large electrical manufacturing companies were included in the report. A list of 57 books was also appended and suggested for the education of salesmen, in addition to the recommendations made for the use of the Solicitor's Handbook and the Cmmercial Section Proceedings as texts for study. The report closed with an abstract of the replies received to nine inquiries directed to representative men in the industry. Discussion turned upon topics of specialization in sales work, remuneration of salesmen by the commission and salary plans, methods of training new men, etc. Several speakers urged that more attention be given the problems of the small plant manager, especially the training of "all-round" salesmen for work in smaller communities.

In a paper on **"Advertising the Electrical Industry by Means of Reading Matter,"** John G. Learned called attention to the commercial value of publicity along other than advertising lines, analyzes the nature and essential features of such publicity, suggests feasible methods for effective results and submits a particular view of the subject for careful consideration by the association and the Society for Electrical Development.

"The Electric Vehicle, the Central Station's Greatest Opportunity," by Edwin E. Witherby, emphasized the desirability of this load from a central station viewpoint. A five ton electric truck with a modern battery would weigh less than a gasoline truck, and that if approval can be found for an electric pleasure car that will only carry one pound of load for every eight to ten pounds of vehicle, it ought to be a simple matter to find approval for trucks where the ratio is one pound of load for every pound of vehicle. In summing up the discussion Mr. Witherby said that over 75 per cent of the central stations of the west are opposed to electric vehicles and that very little development was insured in a territory where the electric light company is entirely neutral.

The report of committee on wiring of existing buildings discussed methods of co-operation between central stations and wiring contractors. In general, the report favors central station soliciting and securing of business, the actual work of construction to be turned over to wiring contractors. This method involves a plan for central stations to quote definite contractor's prices to customers for small and medium-size jobs. A set of units and specifications, the result of estimates and consultations with members from all over the country, suggests unit costs for different kinds of work and list prices which a discount of 50 per cent would give an average net cost. Before anything can be done in the way of standardization of plugs and receptacles, it will be necessary for the industry, including the underwriters, to make a sharp distinction between the articles and devices which should be keep off the lamp sockets while on lighting circuits and, on the other hand, should be kept off both lamp sockets and lighting circuits.

The report of the committee on refrigeration described the various methods of making ice by means of motor-driven apparatus and voiced the desirability of the load from a central station viewpoint. The committee suggested that it is preferable to rate ice making machines in pounds of ice per hour.

Report of rate research committee was confined to a discussion of the existing schedules of some of the larger member companies.

Report of street lighting committee gave data on recent developments in flame ars lamps, which was supplemented by a paper on this subject by W. A. Darrah. A paper on the "Advantages of Copper Clad Wire for Series Arc Lighting" was also presented by T. K. Stevenson.

A lecture on **"Light and Art,"** was given by M. Luckiesch, illustrated by lantern slides, while the sessions were brought to a close with a masterly address on **"Objects of the Society for Electrical Development,"** by Henry L. Doherty.

Accounting Sessions.

The report of committee on "Uniform System of Accounts" brought out very forcibly the fact that all electric lighting industries should take steps towards adopting a uniform sysem of accounts. Public service commissions have already been established in a number of states and the committee anticipates that within the next few years nearly every state in the union will have a commission with power to regulate and control public service utilities and prescribe uniformity in accounting. The committee urges member companies to adopt the uniform system recommended by the association, as this in itself will have much weight in inducing commissions to accept the system. In the discussion it was shown that the system was not applicable to hydroelectric and power transmission companies.

Report of sub-committee on a "Tentative Classification of Accounts, Including Balance Sheet and Indicant Accounts," by John L. Bailey, Consolidated Gas, Electric Light & Power Company. "Handling of Freight Bills," by Albert S. Scott, Public Service Company of Northern Illinois. "Accounting for Replacement of Plant Retired from Service," by Frank A. Birch, Philadelphia Electric Company.

Report of sub-committee on "Statistics and Forms," by C. L. Campbell, United Electric Light & Water Company, and H. Spoehrer, Union Electric Light & Power Company. Paper: "Obligations of the Bookkeeping Department to the Operating Department," by H. Patterson, Rochester Railway & Light Company. Paper: "Handling of Bond Coupons," by W. J. Kehl, Virginia Railway & Power Company.

Hydroelectric and Transmission Session.

Chairman W. N. Ryerson reported signs of a more enlightened conservation policy on the part of the government, public opinion slowly being molded in the right direction. The failure of the New York state hydroelectric scheme by veto of Governor Sulzer was commented upon with pleasure and the balance of the report dealt largely with the evils of overcapitalization, particularly in connection with holding company schemes.

Report of membership committee stated that while the section at the moment totals but 65, a vigorous campaign is afoot for larger numbers. The country has been divided

into four geographical sections with a vice-chairman at the headquarters of each district. Special efforts are being made to bring hydroelectric companies into the organization all over the country.

The paper on **"Failure of Conservation to Conserve,"** by E. H. Thomas, will be published in full in this journal. D. B. Rushmore spoke briefly on the need of educating the public to a real understanding of the situation, and advocated closer connections between citizens and their governmental representatives in dealing with these problems.

The report of committee on progress contained a general review of the events of the year in regard to the question of conservation and cites a number of references, public utterances of national and state officials on the subject, as well as various decisions and actions bearing on the points at issue. Several of the newer plants and systems in the transmission industry are described. Details are given with regard to some of the later projects in this country and Canada, and note is made of various foreign enterprises. Special note is made of the recommendation of official Swedish engineers to use the direct current method for a 200 mile transmission from the Trolhattan Falls to Copenhagen, Denmark, in preference to the familiar three-phase alternating current method.

In the discussion which followed, the excellent efforts of the public policy committee in working against the passage of the New York state hydroelectric scheme was brought out, the speakers being Secretary Martin and Mr. D. B. Rushmore. Dr. C. P. Steinmetz contributed an interesting resume of the relative value of direct current and polyphase transmission, stating that experience and many analyses of propositions show that in the great majority of cases the alterating current method is far superior. The consensus of opinion favoring the alternating current system, Mr. Wright particularly brought out the limitations of commutation in direct current high voltage systems in machines of over 1500 kw. rating.

The report on hydraulic turbines described recent improvements in wheel design and included the consideration of runner wear and material, testing of water wheels and forms of stop and relief valves. The question of runner material for wheels is still open to discussion. Gate valves are no longer necessary in advanced hydroelectric power work. The report contained appendices on the Kingsbury thrust bearing, on water wheel runners and material, and among other material, a paper by Prof. C. M. Allen of the Worcester (Mass.) Polytechnic Institute, on "Efficiency Tests of Waterwheels After Installation."

A paper on **"The New Type of Thrust Bearing"** was presented by Mr. Albert Kingsbury, Pittsburg, on the thrust bearing, of which he is the inventor, with service tests and data. The bearing consists of a rotating collar sliding on stationary supporting surfaces, the whole being flooded with oil. The lubrication is automatic and no high-pressure pumps are required. The bearing is designed to eliminate the objections to vertical shaft turbines. At the close of the paper, Mr. D. B. Rushmore spoke briefly upon the oxidation of turbine blades.

A paper on **"Poles and Pole Preservation"** by R. A. Griffin, gave data on the use and kind of poles, about 700,000 being annually used by electric light and power companies. The author, after describing the various preservative methods maintained that the best method of timber preservation today is the injection of coal tar creosote or dead oil of coal tar into the wood. Any coal tar cresote passing the association specifications can be successfully used; it is only necessary with the brush treatment to apply the preservative to points not over two feet above and below the ground line. Two coats of oil on a 30 ft. butt require about 0.5 gallons of preservative.

A paper on **"Lightning Arresters,"** by E. E. F. Creighton, reviewed the more common apparatus, such as the multigap arrester, the so-called compression chamber arrester and aluminum cell equipment. The use of resistance in series with the cell solves the problem of limiting the charging current to a small value and safeguards the arrester from the effects of heavy dynamic current. A fungus-proof electrolyte has been in use for the past 18 months. The latest practice is to investigate the arrester condition by an ammeter measuring the charging current.

The report on "Operation of Water Power Systems," by Mr. D. B. Rushmore, set forth the efforts now being made to insure reliable and uninterrupted service, touching the efficiency of operating forces, communication, system layout, load characteristics, and water conditions. Practically no hydroelectric development with the capacity of installed apparatus above the rating at maximum stream flow is now built without a steam auxiliary. The general considerations involved in the selection of hydroelectric station apparatus were given considerable space in the report.

"The Keokuk Development" was described by Hugh L. Cooper, in an illustrated lecture.

Report of committee on "Operation of Water Power Systems" emphasized the necessity of reliable and uninterrupted service, and the safe-guarding of the different parts comprising the system. Practically no hydroelectric development with the capacity of installed apparatus above the rating at maximum stream flow is nowadays attempted without a steam station on the system. Consideration must also be given to the causes of disturbances and means for minimizing their effects. These are abnormal or so-called emergency conditions, and in treating of them, the failure of every piece of apparatus and part of the system must be considered as a possibility and a definite plan worked out for limiting the magnitude and area of such disturbances.

A paper on **"Factors Producing Reliability in the Suspension Insulator"** was read by A. O. Austin and one on "Transmission Line Construction" by R. D. Coombs. Dr. S. W. Stratton, also gave on address on "Investigation of Life Hazards of High Tension Lines" by the U. S. Bureau of Standards."

Entertainment.

An elaborate program of entertainment was provided for the delegates and their guests, beginning with the reception and dance on Monday night. On Tuesday afternoon the ladies were given a musicale and tea in the crystal ball room of the Blackstone Hotel and in the evening a colossal circus was given by the Commonwealth Edison Company Section.

On Wednesday afternoon trips were taken to the new Northwest Power House of the Commonwealth Edison Company and the Hawthorne Works of the Western Electric Company. A chamionship baseball game for the Westinghouse cup was played between the New York Edison team and the Commonwealth Edison team, the former being the winners by a score of 6 to 0. The ladies were entertained at the "Pageant of Darkness and Light."

On Thursday the 300 ladies in the party were given a 50-mile automobile trip through Chicago and suburbs, having luncheon at the Hotel Moraine. A large party of men visited the plant of the U. S. Steel Corporation at Gary.

A record-breaking rejuvenation of the Jovian Order was held at the White City on Thursday night, about 200 candidates being initiated into the mysteries of the order. Later nearly a thousand members sat down to supper and enjoyed a cabaret show in the Casino. Jupiter Frank E. Watts was the speaker of the evening.

Exhibits.

A comprehensive exhibit of electrical appliances by the various Class D members in the basement of the Medinah

Temple. By an ingenious and artistic arrangement and decoration a most attractive exhibition was made. In all there were 62 exhibits, comprising 11,000 sq. ft.

At a meeting of the exhibitors the question came up as to whether there should be an independent electrical exhibit at the 1915 convention in Chicago. Chairman J. C. McQuiston stated that he hoped some plan would be worked out whereby the various electrical societies may determine upon dates for holding conventions in 1915 which will make it necessary to make but one trip for many electrical men interested in more than one of the societies.

The general opinion seemed to be that the San Francisco exposition authorities should be urged to provide a separate building for electrical exhibits so that these exhibits may be concentrated rather than scattered throughout the grounds. James I. Ayer offered a resolution, which was adopted, presenting the sense of the meeting that there should be a separate electrical building at the Panama-Pacific International Exposition in San Francisco in 1915. The exhibition committee was instructed to confer with members not present and with other electrical men to see if some action could not be taken to carry out this recommendation.

In relation to the grouping of dates for the San Francisco electrical conventions in 1915, Mr. Gilchrist was appointed a committee to take up the subject with other societies.

Following is a list of exhibits:

Adams-Bagnall Electric Company, Cleveland, Ohio—Flame Arc Lamps. A. J. Selzer, V. N. Marker, C. W. Beach, R. H. Green.

American District Steam Company, North Tonawanda, N. Y.—Models of steam-heating fittings. W. H. Wells, C. R. Bishop, H. C. Kimbrough, B. T. Gifford, A. E. Duram, W. J. Kline, C. A. Gillham, J. A. Bendure.

American Ironing Machine Company, Chicago, Ill.—Electric ironing machines. H. G. Grosse, G. A. Renner, J. L. Mayer.

Bell Electric Motor Company, Garwood, N. J.—Alternating current motors. A. C. Bell, T. R. Bell, A. W. Eckhoff.

Benjamin Electric Manufacturing Company, Chicago, Ill.—Industrial fixtures and lighting specialties. R. B. Benjamin, W. D. Steele, H. E. Watson, A. N. Fox, B. G. Kodjbanoff, F. H. Poss, G. B. Weber, A. E. Lubeck, M. F. Steel, O. L. Johnson.

Century Electric Company, St. Louis, Mo.—Single-phase motors. R. J. Russell, H. A. Porter, E. Kumbo.

Chicago Fuse Manufacturing Company, Chicago, Ill.—Enclosed fuses and conduit fittings. W. E. Finley, A. S. Merrill, W. W. Merrill.

Conlon-Simplex Machine Company, Chicago, Ill.—Electric washing machines. W. J. Conlon, W. T. Haynie.

Co-operative Advertising Service for Central Stations, Chicago, Ill.—Advertising specimens. G. C. Tremaine, R. A. Pick.

Cooper Hewitt Electric Company, New York.—Mercury-vapor lamps. I. B. Carey, G. B. Keech.

Duncan Electric Manufacturing Company, Lafayette, Ind.—Meters and transformers. Thomas Duncan, A. G. Lucas, H. O. Hall, W. H. Sinks.

Duplex Metals Company, Chester, Pa.—Copper-clad wire. S. C. Munoz, T. K. Stevenson, W. D. Ball, W. T. Kyle, W. H. Lipscomb, J. M. Rodger, B. F. Cameron, C. B. Semple, L. M. Garden.

Economical Electric Lamp Works of General Electric Company, New York, N. Y.—Turn-down electric lamps. M. Lobenthal, L. Lobenthal.

Economy Fuse & Manufacturing Company, Chicago, Ill.—Fuses. A. L. Eustice, J. B. Griffith, A. E. Tregenra.

Edison Storage Battery Company, Orange, N. J.—Storage batteries. W. G. Bee, C. B. Frayer, W. C. Andrews.

Electric Appliance Company, Chicago, Ill.—Regulating and protective apparatus. W. W. Low, P. R. Boole, F. J. Alderson, H. Fedde.

Electric Service Supplies Company, Philadelphia, Pa.—Protective devices and line specialties. J. W. Porter, M. A. Berg, O. Mueller, T. H. Henkle, H. H. Johnson.

Electric Storage Battery Company, Philadelphia, Pa.—Storage batteries. G. H. Atkins, T. Milton, T. Cressey, J. Rosholt, E. Kelly, P. Rebel, D. Parker, R. I. Baird, C. Blizard.

Electric Vehicle Association of America, New York, N. Y.—Co-operative advertising for central stations. Harvey Robinson, F. W. Smith, H. E. Niesz, W. J. McDowell.

Electrical Review & Western Electrician, Chicago, Ill.—Electrical periodical. C. W. Price, A. A. Gray, H. S. Tuthill, E. E. Wood, J. B. McCarthy, C. W. Borbich, F. R. Schalck, M. G. Lloyd, F. H. Bernhard, H. Ehrlich, J. E. Latta.

Electrical World, New York, N. Y.—Electrical periodical. James H. McGraw, G. W. Elliott, D. T. Pierce, J. A. Kucera, C. T. Walker, Sam A. Hobson, F. E. Watts, H. T. Matthew, W. H. Onken Jr., W. E. Keily, O. H. Caldwell, H. S. Knowlton, A. M. Perry.

Eureka Vacuum Cleaner Company, Detroit, Mich.—Vacuum cleaners. F. Wardell, R. Field, O. B. Schubert.

Federal Sign System, Electric, Chicago, Ill.—Signs, meters, protective devices and transformers. A. R. Gibbons, A. R. Dean, E. E. Rines, R. J. Wherry, W. J. Devine, J. E. McClernon, F. E. Brown.

General Electric Company, Schenectady, N. Y.—Electrical machinery, apparatus and instruments. F. H. Gale, W. H. McLaren, H. L. Monroe, F. H. Vaughen, N. R. Birge, E. E. Gilbert, A. D. Page, E. D. Payne, D. R. Bullen, C. W. Stone, E. W. Rice Jr., W. H. Coleman, F. N. Boyer, A. W. Burchard.

General Vehicle Company, Long Island City, N. Y.—Electric vehicles. P. D. Wagoner, E. E. Witherby, W. J. McDowell, E. W. Curtis Jr., H. W. Hillman, T. W. Barnes, J. S. Gorham.

G. & W. Electric Specialty Company, Chicago, Ill.—Line and high tension devices. C. P. Edmonds, J. M. Hundley.

Hotpoint Electric Heating Company, Ontario, Cal.—Heating devices. J. R. Richardson, M. J. Wolf, H. A. Ross, W. A. Richards, E. W. Donoho.

Hubbard & Company, Pittsburgh, Pa.—Line material. C. L. Peirce Jr., O. W. Youngquist, W. R. Pounder.

Hughes Electric Heating Company, Chicago, Ill.—Electric ranges, stoves and radiators. G. A. Hughes, A. F. Vaughan, G. J. Brucker, A. Smith, C. E. Marsh.

Hurley Machine Company, Chicago, Ill.—Washing machines and vacuum cleaners. N. C. Hurley, T. J. Casey, R. C. Knopke, O. L. Romme, W. A. Murfey.

Innovation Electric Company, New York—Suction cleaners. F. N. Davidson, L. Bourgette.

H. W. Johns-Manville Company, New York, N. Y.—Protective devices, conduit, refrigeration and insulation. J. W. Perry, H. M. Frantz, H. W. Frantz, G. A. Saylor, W. E. Rapp, R. R. Braggins, R. C. Cole, R. F. Massa, R. J. Stewart.

Life-Saving Devices Company, Chicago, Ill.—Resuscitation apparatus. F. T. Fowler, J. N. Giblin, F. T. Fowler Jr.

W. N. Matthews & Bro., St. Louis, Mo.—Fuse switches and line material. W. N. Matthews, C. L. Matthews, W. Bischoff, J. L. Fay, V. L. Crawford.

Metropolitan Engineering Company, New York, N. Y.—Meter protective devices. T. E. Murray, J. E. McClernon, F. E. Brown.

Minerallac Electric Company, Chicago, Ill.—Maximum-demand devices. H. S. Sines, C. I. Hall, J. Van Buskirk, A. J. Olson.

Moloney Electric Company, St. Louis, Mo.—Transformers. T. O. Moloney, J J. Mullen, L. H. Keller.

National Quality Lamp Division of General Electric Company, Cleveland, Ohio—Incandescent lamps. J. R. Crouse, S. E. Doane, W. M. Skiff, G. S. Merrill, N. H. Boynton, E. J. Edwards, C. W. Bender, Ward Harrison, R. W. Shenton, M. D. Cooper, F. J. Blaschke, R. W. Tavey.

National X-Ray Reflector Company, Chicago, Ill.—Indirect lighting and direct lighting reflectors. A. D. Curtis, H. B. Wheeler, T. H. Aldrich, E. L. Haines, E. E. McKinnie, W. R. Moulton, J. N. Labelle.

Oshkosh Manufacturing Company, Oshkosh, Wis.—Construction tools. J. W. Whooley, R. L. Thayer.

Otis Elevator Company, New York, N. Y.—Elevators. R. W. Charles, H. E. Turner, R. H. A. Carter, E. W. Eaton, E. A. Henderson, E. R. Wilson, H. S. Snead.

Philadelphia Electric & Manufacturing Company, Philadelphia, Pa.—Lighting standards. R. H. Manwaring, W. O. Dale.

Pittsburgh Transformer Company, Pittsburgh, Pa.—Transformers. R. V. Bingay, H. G. Steele, P. H. Butler.

Popular Electricity Magazine, Chicago, Ill.—Electrical periodical. F. W. Harvey Jr., J. A. Harney, H. W. Young, G. T. Hadley, B. E. Blanchard, W. J Wheeler, B. W. Cook.

Sangamo Electric Company, Springfield, Ill.—Instruments and meters. R. C. Ianphier, H. W. Young, J. H. Hodde, A. E. Pickard.

John A. Roebling's Sons Company, New York, N. Y.—Wires, cables and fittings. A. B. Conover, W. J. Slingluff, E. H. Christoph, A. V. Erickson.

Simplex Electric Heating Company, Cambridge, Mass.—Heating devices. J. L. Ayer, E. R. Jacobs, D. Rollins, J. H. Johnson, F. L. McKenna.

Southern Exchange Company, New York, N. Y.—Poles and cross-arms. E. G. Chamberlain.

Standard Underground Cable Company, Pittsburgh, Pa.—Wires, cables and accessories. G. L. Wiley, R. B. Wilcox, J. H. Lytle, C. W. Davis, E. J. Pietzcker, R. C. Houck, J. R. Wiley, W. M. Rogers, R. E. Green, E. F. Norton.

Thompson Electric Company, Cleveland, Ohio—Cut-out hangers. A. J. Thompson.

Transportation Committee, N. E. L. A.

Tungstolier Works of General Electric Company, Conneaut, Ohio—Fixtures. G. C. Webster, F. C. Maxheimer, A. B. Wilson, C. F. Reel, J. B. Higgins, W. G. MacMartin.

Valentine-Clark Company, Minneapolis, Minn.—Butt-treated poles. L. A. Furlong, E. L. Clark.

Wagner Electric Manufacturing Company, St. Louis, Mo.—Electrical apparatus and instruments. W. A. Layman, J. Mustard, E. W. Goldschmidt, E. H. Cheney, F. Johnson, A. J. Meyers, J. A. Gelzer, P. L. Lewis, H. E. Griffin, E. M. Webber, W. R. Patton, R. D. Lillibridge.

Western Electric Company, New York, N. Y.—Appliances, line and supply material, telephone apparatus. H. R. King, R. A. Griffin, A. G. Kingman, H. L. Grant, J. F. Sweeney, W. B. Pierce, W. Mueller, J. R. Kearney.

Western Water Supplies Company, Kansas City, Mo.—Electric sterilizers and coolers. P. Thompson, J. H. Thompson.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.—Electrical machinery, apparatus, instruments and appliances. L. A. Osborn, S. L. Nicholson, G. B. Griffin, C. S. Cook, A. A. Brown, M. C. Rypinski, D. E. Drake, H. W. Cope, J. J. Gibson, S. A. Chase, E. P. Dillon, J. C. McQuiston, W. A. Thomas, G. C. Ewing, J. M. Duncan, W. Clegg, C. E. Heise, K. E. Van Kuran, J. S. Tritle, G. S. Vail.

Westinghouse Lamp Company, Bloomfield, N. J.—Incandescent lamps. Walter Carey, T. G. Whaling, B. F. Fisher.

Westinghouse Machine Company, Pittsburgh Pa.—Prime-mover apparatus. E. H. Sniffin.

Weston Electrical Instrument Company, Newark, N. J.—Instruments. G. P. Frey, P. Westburg, R. Johnson.

Wilkinson Company, Chicago, Ill.—Portable lamps. I. A. Jones, R. A. Soukup, O. C. Helm, O. Hoehberg.

GENERAL ELECTRIC COMPANY'S NEW REPAIR SHOPS AND LABORATORY.

BY JOHN HOOD.

The General Electric Company has for several years past realized the desirability of maintaining, as an adjunct to its district engineering department, adequate facilities for carrying on locally the repair and alteration work necessary to ensure effective service to its customers. The repair shop, instituted to meet this condition, has until recently been

Exterior.

located at 942 Bryant street. Due, however, to the increase in the business carried out by this department, the company has found it necessary to secure larger and better quarters wherein work could be properly cared for. At the present

General Interior View.

time a force of 46 men is maintained in the shop and laboratory. This force is now occupying the new two-story brick building at Seventeenth and Kansas streets, which has been designed to meet their special shop and laboratory requirements. The new structure has a floor space of 11,000 sq. ft., The center aisle, 22 ft. wide, is open from the lower floor to the roof to provide for the movement of the 7½ ton electrically operated crane which travels the full length of the building. The crane tracks are extended out four feet beyond the front of the building in order to facilitate loading and unloading trucks at the front door. The crane also runs directly over a pit 8 x 10 ft. and 8 ft. deep, which has been excavated at the rear end of the building to facilitate dismantling large transformers. This pit eliminates trouble which would otherwise be experienced due to lack of headroom in hoisting the windings and core of a large transformer out of the tank.

Winding Department.

The south wing of the lower floor is devoted exclusively to machine work, the equipment consisting of the usual lathes, planers, shapers, drill presses, etc., necessary for general machine shop practice, and such special tools as are particularly adapted to the class of work handled by the shop. These are driven by direct current motors, each motor

Machine Shop.

handling a group of machines, the groups being arranged in such a manner as to utilize each driving motor to the best advantage. The equipment is laid out to obtain the best possible light on the work from the windows on the south frontage of the building. This south wing faces on Seventeenth street and has been arranged in such a manner as to give the maximum window area. Excellent light, which

is a prime essential to accurate work, is therefore assured to the shop even on cloudy days. The shop has, however, been carefully arranged for adequate artificial lighting by Mazda lamps and Holophane reflectors to take care of night work.

The north wing of the lower floor is occupied by the office of the shop foreman, tool room, carpenter shop, blacksmith shop, and clothes-locker room. The carpentry and blacksmith work done is such as would ordinarily be carried out

Laboratory Views.

in conjunction with general machine and electrical repair work, including the crating of apparatus for shipment. The south wing of the gallery floor is occupied by the winding and general electrical repair department. This wing is abundantly lighted from the large south windows and a very considerable part of the shop work is carried on here. A suitable equipment is installed at convenient points along the benches for the purpose of testing small motors and other devices. By a simple switching arrangement various voltages both alternating and direct current may be obtained for this work. Motors too large to be handled on the bench are mounted on stands conveniently placed where re-winding and repair work can readily be carried out. Polyphase testing is carried out at the rear end of the building where a special equipment has been installed to conveniently and effectively carry out this work. A vault has been excavated under the Seventeenth street sidewalk and the incoming 2200 volt 2-phase feeders from the power company's line are connected to the special transformers in this room. These transformers consist of two banks, each bank composed of two 25 k.v.a. units, 2200 volts primary, 440/220/110 volts secondary. Suitable taps are brought out from the secondary windings to drum controllers for the purpose of securing any of the above mentioned voltages on either two-phase or three-phase connection. The transformers are arranged in two banks in order that two separate tests may be conducted in the shop at the same time. Each drum controller is mechanically connected to a dial which indicates the voltage and phase at any given position. Transformer taps are arranged progressively, that is 110/220/440 in order that the equipment may be used for starting motors at reduced voltages, advancing from tap to tap by means of the controller until the full voltage is obtained. Switchboard panels, especially designed to permit the plugging in of instruments in order to facilitate testing have been installed thus making the equipment thoroughly complete.

The vault containing the special transformers performs, in addition to isolating the 2200 volts from the main body of the shop, another important function. The portion of the vault nearest the door of the compartment is fenced off from the transformers and is used as a storeroom for paints, oils, varnish and other inflammable liquids. The vault proper is constructed of concrete and brick and has a floor 12 ft. below the level of the main shop floor. This construction is relied upon to isolate any fires which may occur in the inflammable material mentioned. The fact that the vault floor is below the level of the main floor would effectively prevent any burning liquids from running out into the shop. The shop as a whole has been adequately provided with suitable means for protection against fire.

The north wing of the gallery floor is occupied by the Standardizing Laboratory which is equipped to do standardizing and repair work on all classes of instruments and meters. The laboratory has been very carefully laid out in such a manner as to have the repair work isolated from the testing and standardizing instruments, thus avoiding any possible trouble due to dust filings, etc. A complete equipment of primary and secondary standards are maintained as well as special machines and instruments for delicate instrument testing.

A single story building has been constructed on the north side of the main shop, the front 800 sq. ft. of which is used for garage purposes. In this building the electric delivery trucks used by the General Electric Company in San Francisco are housed and charged. The part of the building at the rear of the garage is used as a storage department for special tools and equipment used by the construction force.

The entire plant has been laid out with a view toward meeting every condition likely to rise in connection with such mechanical and instrument work as the General Electric Company handles on the Pacific Coast.

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CONTENTS

Electrical Irrigation

Sixty years ago the inhospitable wastes of the Great American Desert were regarded merely as a barrier to the prairie schooner and the pony express straining for the Eldorado beyond. Today the rail is the trail and the decapod the ox traversing an inland empire constituting two-fifths of the area of this country and forming the basis of a substantial agricultural prosperity. The transforming elixir in this "before and after" scene is water, wisely conserved and judiciously distributed.

The first people to develop the latent possibilities of the fertile soil were the Mormons at Salt Lake. Many an argonaut, disappointed in his search for gold, did likewise and found a more enduring fortune. The land is arid but it is not desert. The soil is fertile and lacks but moisture to bring forth abundant vegetation. Cloudless skies allow the sun's heat to force plant growth to rapid fruition, and water, artificially supplied, eliminates chance of the crop being spoiled by rain.

Instead of clouds there are snow-capped mountains and ideal reservoir sites that require but the connecting link of the ditch or pipe line to supply water when and where needed. There is, however, much fine land above the level reached by irrigating canals. Even where it is possible to seek a higher source it is often cheaper to pump from the ditches than to build a longer line. It is here that the simplicity and reliability of the electric motor forms an indispensable adjunct. Much of the electric power used in irrigation is generated by water. It seems fitting then in turn that it be used as motive power for pumping, thus in a way liquidating its debt.

The irrigation is of such magnitude and so expensive as to be beyond the scope of private enterprise and consequently there is no finer work being carried to completion than the great irrigation projects that have been undertaken by the United States Reclamation Service. As these are gradually finished, the power companies, supplying energy in districts thus benefited, will find the farmer to be their best consumer.

The Hydraulic Analogy

Water in motion has a peculiar resemblance to several other more complex physical phenomena. These can be better explained by a comparison of similarities than by any other method. Just as short, familiar Anglo-Saxon words often express our thoughts more clearly than do words of Greek origin, so does our intimate knowledge of moving water enable it to explain many subjects more clearly than do mathematical formulae. Simple analogies are of great assistance alike to the novice and to the adept.

One of the most useful is that employed in explaining electrical phenomena, whose intangibility causes it to elude our understanding. The familiar illustration of a man swimming in a current to indicate magnetic deflection, was first used by Ampere. In elementary books the electric current is often likened to water flowing under pressure in a pipe. The resistance of the wire is compared to the friction in the pipe, the amount of current to the volume of water delivered,

and the voltage due to the difference of potential to the pressure due to the difference of water level. One writer has carried this analogy further, representing the inductance of an alternating current by a water-wheel carrying a heavy fly-wheel, the lag corresponding to the inertia of the wheel. He explains condenser and capacity phenomena by means of a chamber with two outlets divided by a flexible rubber diaphragm that stores excess energy.

The hydraulic analogy is also useful in explaining the action of steam in turbines. Just as all hydraulic turbines may be grouped under two main heads of reaction and impulse wheels, so may steam turbines. Hero's turbine, first used by the priests of ancient Egypt, employed the reaction principle, as does also the Parsons, Schulz, and Zolly. Branca's turbine of the seventeenth century was similar in action to the impulse water-wheel, as are likewise the De Laval, Rateau, and Curtis. The impulse turbine, whether water or steam, utilizes the velocity of the moving fluid, while the reaction wheel employs both velocity and pressure. Water pressure is due to head, steam pressure to expansion, which imparts a high velocity to the steam particles and causes them to act on the wheel-vanes so as to produce rotation. The essential principles of the flow of water in pipes have been successfully applied to moving gases, and many other instances will probably suggest themselves to the reader.

An analogy might well be termed an engineer's parable. Both parable and analogy are based upon a simple likeness from which deeper relations may be inferred by comparison. Certain moral truths are made more easy of comprehension by means of parables. Similarly, many scientific facts are more easily understood through analogy. In using this powerful tool, however, there is one precaution to be observed—while phenomena may be analogous, they are not identical, and care should be taken to prevent the idea presented by analogy obtaining so firm a hold on the observer's mind as to blind him to realities. It should be remembered that a comparison is a concession, that it is usually given to supply a lack of technical knowledge, and is to that extent misleading. An analogy is an aid to understanding, but not a substitute for it.

N. E. L. A. Convention

The Thirty-sixth Annual Convention of the National Electric Light Association, now a matter of history, was one of the greatest conventions of its kind ever held. The past thirty-six years have witnessed developments in the electrical world with which no other applied science can compete. Although still in its infancy, electricity today is the most exact of all sciences; mathematical theory and practical application follow each other so closely that results can be predicted with extreme accuracy; electrical measurements can be made more accurately than any others; and there is less guess work and fewer safety factors used than in any other branch of engineering. The capacity of copper cables necessary for a transmission line can be calculated accurately within a small per cent, while the very tower which supports them is often made unwieldy by the guess work employed in its design. That the rapid development made along these lines is due in greater part to the unselfish, co-operative efforts of the National Electric Light Association cannot be denied. The zealous, untiring efforts of this association, combined with the energies of other societies recently organized for the purpose of furthering electrical interests, point to a future even more phenomenal than the past.

The Engineer in the Civic Service

The engineer is so busy with materials that he neglects men. He controls the power of water, steam or gas, but he does not guide human affairs. His judgment is sought on the strength of materials, but is sometimes faulty on the strength of human character. Leadership of men is a specialized business in which the ordinary engineer has not perfected himself, and consequently he is frequently overlooked in political service, especially in the selection of a public service commission which is supposedly made up of "broad-minded men of affairs, who know the community and are beyond the suspicion of corporation influence." This criterion is one reached by many engineers whom we all can name, but unfortunately their qualifications are not known to the political powers. The engineer has not taken the trouble to cultivate the acquaintance of the politician.

He is perhaps no more blameworthy in this respect than the great majority of men, some of whom do not take the trouble to vote. If some men did not make a business of politics, if they did not organize and mold public opinion, it would be but a few years before self-interest would divorce many of us from an interest in community affairs. The political machine is making plans for the next campaign while the reformers are rejoicing over their temporary victory. The regular army usually gets away with the militia.

It therefore behooves the engineer to think and talk of something besides "shop." His training and his experience have eminently fitted him to direct those matters which now concern our government. Many municipalities are issuing bonds for public improvements, sewers, water-works and roads. They are interested in regulation and control of public service corporations. These are functions for whose discharge the engineer is peculiarly qualified .

He will naturally say that his duties are so all-absorbing as to preclude the possibility of his taking an active interest in things political. Civic service is a duty that we owe to the country to which many of us are indebted for our education. In European countries this debt is compulsorily paid in military service. In this land of liberty the service which an engineer can render should at once constitute his duty and his happiness. From the ground of public duty, the engineer should take a more active and practical part in the administration and direction of public affairs. The market price of liberty has ever been the same—eternal vigilance; and if we think our political institutions are worth continuing, it is up to just such men as the engineers to lend efficient service in securing such perpetuity.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

J. B. Lukes returned from Portland this week

B. C. Condit of the Northwestern Electric Company, of Portland, was in San Francisco this week.

C. W. McKillip of the Sacramento Gas & Electric Company, was a visitor in San Francisco last week.

H. G. Behneman, manufacturers' agent, Seattle, is taking a six weeks' trip through the Eastern states, visiting different factories.

Robert Howes, electric and hydraulic engineer, Seattle, has returned from a business trip to Spokane and points in British Columbia.

S. V. Carter, president of the Pacific States Electric Company, left Tuesday evening to spend a few days in Los Angeles and the south.

F. D. Phillips, former City sales manager, has been appointed general sales manager of the Wesco Supply Company, St. Louis, Missouri.

J. H. Kelley, assistant treasurer of the Western Electric Company, Seattle, has been called to San Francisco by the death of his mother.

F. H. Leggett, manager of the Western Electric Company, and Mrs. Leggett, left the early part of the week for a trip to Seattle and the northwest.

P. B. Clapp of Los Angeles reports another Jovian statesman rejuvenation to be held June 13th. About thirty candidates are to be initiated.

J. H. Jamison of the Spokane office, Westinghouse Electric & Manufacturing Company, is spending his vacation at San Francisco and Los Angeles.

O. F. Swenson, engineer with Hunt, Mirk & Company, San Francisco, is making a trip to Portland, Seattle and other cities of the northwest in the interest of his firm.

Percy H. Ridgway, electrical engineer, Seattle, has become connected with the Reynolds Electric Company of that city and will look after the company's steam and power plant work.

John A. Britton was elected first vice-president of the N. E. L. A. This is significant, as the usual procedure follows that he is to be president next year, assuring San Francisco of the convention in 1915.

J. L. Wright of the sales department of the General Electric Company at Seattle and his bride spent a few days in San Francisco en route to Los Angeles, his former home, where they expect to spend the greater part of their honeymoon trip.

S. L. Sheffleton has just returned from Portland, where he has been visiting the White Salmon River power plant recently finished by Stone & Webster. **J. H. Manning**, who was superintendent of construction on this project, is also back at the San Francisco office of the company.

D. F. McGee, chief engineer of the Pacific Power & Light Company, of Portland, Ore., is attending the N. E. L. A. convention. Mr. McGee was one of the organizers and was later president of the Iowa Association. After the convention he will visit the New York offices of the American Power & Light Company, which is interested in the Pacific Power & Light Company. **Lewis A. McArthur**, assistant general manager of the Pacific Power & Light Company, also of Portland, is attending the convention with Mr. McGee.

H. J. Gille, chairman of the Commercial Section of the N. E. L. A. in 1912, has been appointed commercial manager of the Stone & Webster properties in the Puget Sound District, with headquarters at Seattle. Mr. Gille's work in the "business end" of the industry, and his successful connections with the St. Paul Gas Light Company and the Minneapolis General Electric Company, have fitted him admirably for his new responsibilities which will cover the advancement of Stone & Webster service throughout a large portion of the Northwest.

ANNOUNCEMENT.

Pierson, Roeding & Company announce the election of Mr. Thomas Finigan as vice-president of the company, succeeding Mr. Safford K. Colby, resigned. Mr. Colby will continue as a director of the company.

MEETING NOTICES.

Electric Development and Jovian League.

The semi-annual business meeting was held during Tuesday luncheon hour at a downtown cafe, some thirty or more members being present. Treasurer's and reports of the standing and appointed committees of the League were read and adopted.

Report made by the nominating committee appointed at a previous meeting as unanimously adopted follows:

President, W. S. Berry; vice president, W. F. Neiman; members of the executive committee for the term ending June 30, 1914, H. R. Noack, F. J. Cram.

Electrical Credit Men's Association.

The annual meeting was held June 3 at the Stuart hotel, San Francisco, President W. A. Blair presiding. Secretary A. H. Elliott read the annual report, showing operations of the association during the past twelve months.

Addresses were made by W. W. Briggs of Great Western Power Co.; Fred Skeel, Crouse Hinds Co., Syracuse, N. Y.; H. V. Carter and W. L. Goodwin, Pacific States Electric Co.; F. H. Leggett, Western Electric Co.

Members present were Messrs. C. C. Hillis and H. J. Zweifel of the Electric Appliance Co.; A. M. Erwin, R. F. Behan. C. E. Thompson, of Westinghouse Electric and Mfg. Co.; F. G. Beck, Am. Eveready Co.; S. Taylor, Electric Ry. & Mfgrs. Supply Co.; H. Sayles, Holabird Reynolds Co.; H. Von Haggen, Thos. Day Co.; W. M. Levensaler, Dunham, Carrigan, Hayden Co.

The following officers were elected for the ensuing year: President, J. Gray, of Western Electric Co.; vice-president, H. Von Haggen, Thos. Day Co.; executive committee, C. C. Hillis, S. E. Kearny, W. A. Blair.

Los Angeles Section A. I. E. E.

At the annual election of the Los Angeles Section of the American Institute of Electrical Engineers, the following officers were elected for the year 1913-14: Chairman, E. R. Northmore; secretary, C. G. Pyle; assistant secretary, Edward Woodbury; executive committee, J. A. Lighthipe, James E. Barker, George A. Damon, Arthur W. Nye.

Electrical League of Southern California.

At the last meeting of the Electrical League of Southern California held at the Angelus Hotel, on Tuesday, June 10th, Dr. Loye Miller of the State Normal School gave a talk on "Fossil Beds of Rancho La Brea" which was thoroughly enjoyed by all present.

Oregon Electrical Contractors' Association.

The semi-annual meeting of the Oregon Electrical Contractors' Association was held in the hall of the P. R., L. & P. Company, corner of First and Alder streets, Monday evening, June 9th, at 8 o'clock. An illustrated lecture on indirect

illumination by Mr. J. L. Bradfield, northwest representative of the National X-Ray Reflector Company of Chicago, was thoroughly enjoyed by all present. Mr. Murphy, illuminating engineer for the P. R., L. & P. Company, also gave a talk to the members.

Oregon Technical Club.

The regular weekly meeting of the Oregon Technical Club took place, at noon on June 2nd at the Portland Commercial Club. Mr. O. E. Stanley was chairman of the day. Mr. W. H. Crawford spoke on "The Necessity of Every Organization Having an Ideal Towards Which to Work."

Seattle Jovian League.

The meeting of the Seattle Jovian League held at the Rathskeller on Friday, June 6, was largely given over to the cleaning up of unfinished business. The report of the committee having in charge the matter of a proper float for the League during Potlatch week, was accepted and the committee continued with instructions to see after construction of the float or pageant. The resignation of Chairman C. M. Bliven was accepted and R. Worth, northwest manager of the American Ever Ready Company was elected to fill the vacancy. V. A. Welman of the H. W. Johns-Manville Company was made chairman of the degree team committee. The rejuvenation is to be held some time in September and it was unanimously voted that meetings should be held each Friday instead of taking the regular summer vacation. This was considered necessary in order to make a success of the part to be taken by the league in the forthcoming Potlatch festivities and in order to make sure that enthusiasm will be kept at white heat for the rejuvenation in the fall.

WASHINGTON PUBLIC SERVICE COMMISSION.

The Washington Public Service Commission has decided that the Malden Supply & Power Company and the Rosalia Telephone Company have been excessive in their charges for telephone service. The plant is valued at $6884, reproduction cost, while the telephone system between the two places is valued at $909. The rate for long distance service between the two places has been cut from 15 cents to 10 cents. The 10-cent messenger fee heretofore charged on incoming messages at Malden was ordered eliminated as it was found no messenger service had been provided. Hereafter service must be full 24 hours instead of 15 hours on week days and 7 hours on holidays and Sundays.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

A decision was rendered granting authority to the Southern California Gas Company to issue $750,000 of preferred stock, the proceeds of which will be used for making improvements and for retiring obligations.

The Southern California Edison Company was granted a certificate of public convenience and necessity to construct an electric distribution system in Beaumont.

A decision was rendered granting the application of the Southern California Edison Company to purchase the electric distribution system of the Pacific Electric Company, in Gardena, Moneta, Clifton and Redondo Beach, for $17,500.

A decision was rendered granting authority to the California-Oregon Power Company to buy the electric light and power plant of George H. Johnson, at Sisson, for $15,000.

A decision was rendered granting authority to the California-Oregon Power Company to purchase the electric light plant of R. E. Cavanaugh at Edgewood, Siskiyou County, for $10,000.

An order was issued extending the effective date of the decision in the case of the Oro Electric Corporation during the pendancy of the application for rehearing.

A complaint was filed against the Pacific Gas & Electric Company by the town of Antioch, asking that the commission fix the rates for electricity.

The railroad commission has rendered a decision granting authority to the Los Angeles & San Diego Beach Railway Company to issue notes in the sum of $28,000 to be used in payment for Edison storage battery motor cars to be used on the company's system between San Diego and La Jolla.

The commission has rendered a decision granting the application of J. H. Evans to extend his telephone system into Patterson. The commission disapproved of the original plan of Mr. Evans to discount by 25 per cent all bills paid before the tenth of the month, and recommended instead that the rates should be reduced by 25 per cent. The commission finds that Mr. Evans may levy an excess charge of 10 per cent for all bills not paid before the tenth of the month.

The commission has rendered a decision granting authority to the Pacific Gas & Electric Company to sell to the San Jose Water Comapny certain property and water rights along Los Gatos Creek, Santa Clara county, for $25,000.

The Torrance Water, Light & Power Company has filed an application with the railroad commission asking for authority to issue 50,000 shares of stock and $125,000 of 6 per cent bonds, and to use the proceeds in purchasing the water system recently owned by the Dominguez Land Company and conveyed to Ralph Bennett and E. C. Dicey, trustees.

The San Diego Consolidated Gas & Electric Company has applied to the railroad commission for authority to issue $639,000 of its 5 per cent first mortgage bonds. The proceeds from the sale of the bonds are to be used to pay existing indebtedness and to reimburse the treasury in the sum of $180,000 and the balance of $459,000 is to be used to make the necessary extensions to the company's plant during the year. The company also asks for authority to sell 3148 shares of its capital stock, to be used for the purpose of liquidating its existing indebtedness.

The commission has rendered a decision granting authority to the San Jose Water Company to issue $100,000 in notes. The money is to be used in paying off existing notes in the sum of $46,000, for new construction in the sum of $29,000, and to pay the Pacific Gas & Electric Company for water rights on the Los Gatos Creek in the sum of $25,000.

TRADE NOTES.

The American Electric Company, Seattle, recently installed a 6 kw. generator plant on the ranch of Mrs. Sanders at Ellensburg, Washington.

The Westinghouse Electric & Manufacturing Company, Seattle, has sold to the Issaquah & Superior Coal Mining Company, Ltd., a 300 horsepower, 200 r.p.m., 3-phase, 2200 volt, self-starting synchronous motor, complete with exciter and switchboard, for direct connection to a compressor.

In view of the present relations between the Pacific Coast States and Japan over the legislation against aliens holding land, the shipment which left the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company last week is of particular interest. This shipment consisted of 25 freight cars loaded with machinery for Japan. It is to be used in connection with the large water-power development of the Inawashiro Hydroelectric Power Company, which is building a large plant about 145 miles from Tokio. The current will be generated at this point, and stepped up to 115,000 volts, which is the highest voltage ever used in Japan. From this point it will be transmitted to the city of Tokio, where it will be used for furnishing light and power. The shipment consisted of eight 4000 k.v.a. and four 150 k.v.a. O. I. C. W. transformers, two motor generator sets and a quantity of switchboard material. The total weight of the shipment was 913,972 pounds.

JOBBERS MEET.

It has been said that "it is well men should dwell together in unity." Its fulfillment may be justly applied to the Pacific Coast Jobbers. Their quarterly convention was held at Del Monte from Wednesday to Saturday of last week.

Convention—no, that is hardly the term. It is just one big family gathering; husbands, wives, families, sweethearts and friends, forgetting business or the hum drum of home routine, getting out with Nature, and just being kids again for a few days.

Miss Russell although but two, wins in the golf tournament having found the nineteenth tee.

They came from most every quarter of the Pacific Coast to join in the merry-making—from Los Angeles on the south to Portland and Seattle on the north—and when an Eastern friend is due to hit the coast about the time of one of these outings, he usually plans his itinerary so as to drop in in an off-hand sort of way and break bread with the family. If you're not on just get next to jolly Fred Skeel from Syracuse.

What do they do? you ask. Well, they just do everything from batting little white pills all over creation, to doing each other. Unfortunate is he who gets between the pill and creation. They yell "fore" at him till he wishes for a cyclone cellar or a short line to Mars. Besides the golf and pool tournaments, which carried cups for the winners, there were games for the ladies, automobile trips, tennis, billiards and dances in the evening.

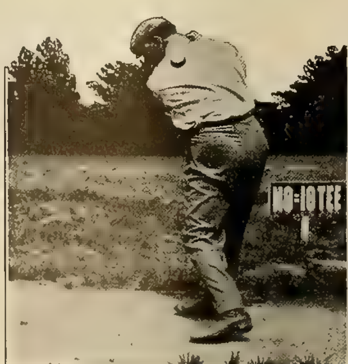
C. C. Hillis sizes up the bunch.

You have often met him face to face. He says he's for Albert H. Elliott and the Jobbers first, last and all the time.

The golf tournament aroused much interest and friendly rivalry. One of the most unusual features being that of son playing against father in the finals for Arrow E cup, when it devolved upon H. C. Carter to show daddy how to do it. W. H. Goodwin came out with the lowest gross score, with W. S. Berry next, the latter winning the contractors' cup, according to the stipulations accompanying it, on this record, after six years of "almost won." T. E. Berger was right on the job, taking the Jobbers, Patton and Del Monte cups, the latter being a permanent trophy. The manufacturers' cup was won by S. B. Gregory in the tryout over W. R. Dunbar, his tying opponent, by four strokes. F. N. Averill defeated all opponents in the pool tournament, winning the cup.

	Jobbers and Patton Cups. Net.	Eveready Cup. Net.	Manufacturers' Cup.
W. S. Berry	110	101	
T. E. Berger	90	106	
H. D. Brainard	105	102	
H. V. Carter	106	104	
C. H. Carter	104	97	
J. G. Clapp	...	...	100
W. R. Dunbar	...	...	97
A. H. Elliott	114	102	
W. L. Goodwin	104	109	
N. W. Graham	112	...	
S. B. Gregory	...	...	97
C. C. Hillis	108	108	
P. B. Hyde	...	...	111
T. H. Leggett	97	106	
R. F. Oakes	...	...	100
J. G. Pomeroy	...	115	
S. P. Russell	...	...	102
H. E. Sanderson	...	...	107
W. H. Seaver	...	...	108
G. Young	...	...	106

Col. Carter takes to the field.



W. L. Goodwin "beating it."

W. S. Berry on the "green" at ninth.

A business meeting was called for Friday morning, 9:30, to arrange for a salmon fishing expedition on Monterey Bay. The fishermen appeared at the appointed hour with "Sandy" coming in by a nose but afterward confessing he would like a moment to locate a strawberry and a cup of coffee. Father Time beat "Buster Cole" to the meeting by a couple of minutes, who likewise pleaded for a couple of minutes to locate a coffee and macaroon. In view of the precarious situation of the two gentlemen, an adjournment was taken, it having leaked out in the meantime that politician Goodwin had all the available supply of boats subsidized. For "ways that are dark and tricks that are," well, leave it to Bill.

Friday evening practically concluded the meeting, the occasion being celebrated by a banquet presided over by H. V. Carter. Addresses were made by many present, the speech of the evening being delivered by Albert H. Elliott, who told for the last time his turntable story. It seemed to be a three-cornered play between Roscoe Oaks, T. E. Berger and H. E Sanderson as to who had the greatest vocal powers, Brewster Hall being the object of their efforts.

Gearheart, Oregon, was selected as the place for the September meeting.

Those in attendance were:

Mr. and Mrs. H. D. Brainard, Western Electric Co., Seattle.
Mr. and Mrs. J. A. Herr, Sprague Electric Works, San Francisco.
Mr. and Mrs. H. N. Lauritzen, Holophane Co., San Francisco.
Mr. and Mrs. F. H. Leggett, Western Electric Co., San Francisco.
Mr. and Mrs. J. G. Pomeroy and daughter, Central Electric Co., Los Angeles.
Mr. and Mrs. R. F. Oaks, Am. Eveready Co., San Francisco.
Mr. and Mrs. H. E. Sanderson, Bryant Electric Co., San Francisco.
Mr. and Mrs. A. G. Young, Telephone & Electric Equipment Co.
Mr. and Mrs. F. N. Averill, Fobes Supply Co., Portland.
Mr. and Mrs. W. B. Hall, Pass & Seymour, San Francisco.
Mr. and Mrs. T. E. Burger, Western Electric Co., Los Angeles.
Mr. and Mrs. C. C. Hillis, Electric Appliance Co., San Francisco.
Mr. and Mrs. J. W. Redpath, Journal of Electricity, Power & Gas. San Francisco.
Mr. and Mrs. S. P. Russell and daughter, H. W. Johns-Manville Co., San Francisco.
W. S. Berry, Western Electric Co., San Francisco.
H. V. Carter, Pacific States Electric Co., San Francisco.
John R. Cole, Manufacturers' Agent, San Francisco.
H. H. Daley, Westinghouse Electric & Mfg. Co., San Francisco.
W. R. Dunbar, Westinghouse Electric & Mfg. Co., San Francisco.
A. H. Elliott, Secretary Jobbers' Assn., San Francisco.
C. L. Gilson, Pacific States Electric Co., Oakland.
W. L. Goodwin, Pacific States Electric Co., San Francisco.
S. B. Gregory, Arrow Electric Co., San Francisco.
C. H. Carter, Pacific States Electric Co., Los Angeles.
P. B. Hyde, Electric Battery Supply Co., San Francisco.
F. H. Murray, National Carbon Co., Los Angeles.
N. W. Graham, Holabird-Reynolds Electric Co., Los Angeles.
C. E. Wiggin, Dunham, Carrigan & Hayden, San Francisco.
E. M. Cutting, Edison Storage Battery Co., San Francisco.
P. B. Clapp, Westinghouse Electric Mfg. Co., Los Angeles.
F. Fowden, Brooks Follis Electric Co., San Francisco.
F. G. Skeel, Crouse Hinds Co., Syracuse, New York.

How we worked(?) at Del Monte. W. L. Goodwin talking it over with Knee-high Wiggin.

ELECTRICAL CONTRACTORS.

The electrical contractors will furnish the entertainment at the meeting of the Electrical Development & Jovian League Tuesday, June 17th. The contractors promise something good and will distribute five useful prizes to the lucky ones.

A neat poster has been distributed among the trade advertising the California State Association's convention at Santa Barbara, August 13-16, 1913.

The General Electric Construction Company was the lowest bidder on the wiring of the Appraisers' Building, at San Francisco, their bid being $8300.

Bids are being received for two 75 kw. generators for the Letterman Hospital at the Presidio, San Francisco.

The National Association have reorganized the California State Association by nominating J. C. Rendles the State President, as third vice-president of the National.

Get Busy.

If you haven't already completed your plans for attending the annual meeting in Chattanooga in July "get busy."

You can't afford to miss this meeting if you take any interest in getting points on improving your business conditions and that of the entire trade.

If you don't go you will feel like the member who failed to attend the last meeting.

The program, which we reprint below, assures you of plenty of time for the business of the organization and also an opportunity for a mighty good time.

On Tuesday, July 15th, the meeting of the Directors and Executive Committee.

On Wednesday, July 16th, the opening of the convention proper. The open session will be at 10 a. m. on the morning of this day with three prominent speakers. A business session will be held at 2 p. m., for members only. At 8 o'clock there will be a reception and dance at the Hotel Patten, and during this reception will be introduced a genuine southern negro cake-walk for large prizes.

On Thursday, July 17th, there will be a business session for members only at 10 a. m. In the afternoon of this day there will be an automobile trip, starting from the headquarters at 2 o'clock, going over the battle fields, Chickamauga Park, and to Fort Ogelthorpe. At the fort there will be a special cavalry drill for the benefit of the convention visitors, which will prove one of the great attractions of the convention for many of the members and guests.

In the evening an illustrated lecture on "Illumination" at 7 p. m., and 9 p. m. a Rejuvenation of the Sons of Jove.

On Friday, July 18th, there will be two business sessions for members, one at 10 a. m., and one at 2 p. m. The ladies and guests will be given an afternoon tea at 3:30 p. m. by the Chattanooga Electric Club. The annual dinner of the association will be held at the Hotel Patten at 8 p. m. on the evening of this day, and will be followed by a very attractive vaudeville performance.

Saturday, July 19th, will be the last day of the convention and will be given up to an outing. At 10 a. m. those attending the convention will leave the hotel for a trip over Waldron's Ridge to Signal Mountain. Lunch will be served at the new Signal Mount Inn at about 12:30, and after lunch the trip will be continued, returning to Chattanooga at 2:30 in the afternoon. The return will be directly to the Union Station and from this point a special train will take the party down to the Tennessee Lock and Dam, where an inspection will be made of this wonderful piece of work. Approximately two hours will be spent at this point and the party will return by a special train, arriving in Chattanooga in time to connect with the evening trains out of the city.

You need the information you will get at the meetings and the association needs your assistance in planning the work for the coming year.—Get Busy!

NEWS NOTES

INCORPORATIONS.

HOLTVILLE, CAL.—No. 3 Water Company has been incorporated with Brawley as headquarters, with a capital stock of $60,000.

LOS ANGELES, CAL.—All electrical interests in Santa Barbara, San Luis Obispo and Fresno counties have been merged into one corporation under the name of the Midlands Public Service Company, with a capital of $2,500,000. W. G. Karchoff, T. C. Balch, Kaspar Cohn, Abe Haas and A. G. Wischon are the incorporators. The companies taken over are the Russell Robinson Water & Electric Company, at Rio Grande; the plant at San Miguel; Coalinga Water & Electric Company; Paso Robles Gas & Water Company; Midland County Company at Santa Maria and San Luis Obispo. The new corporation will secure electric power from the San Joaquin Light & Power Company, which has been extending its lines into this territory, and will devote special attention to the development of agricultural lands by furnishing power for pumping.

ILLUMINATION.

BERKELEY, CAL.—The city council has awarded the contract for lighting the streets and public buildings of Berkeley to the Pacific Gas & Electric Company.

GLENDALE, CAL.—At a recent election held at Casa Ferdugo and North Glendale, it was voted that these two localities should be formed into an electric lighting district.

OROVILLE, CAL.—The supervisors have granted the Great Western Power Company a franchise in Butte county, giving it the right to erect power poles and string wires.

PUYALLUP, WASH.—Aswell Bronfield has been engaged to investigate conditions and report on the feasibility of constructing a municipal hydroelectric plant at Salmon Springs.

LOS ANGELES, CAL.—The board of supervisors has let the contract to the Pacific Light & Power Company for the installation of street lamps along Laurs Canyon road, from Sunset boulevard to Lookout Mountain Park.

REEDLEY, CAL.—A. W. Webber and R. W. Wilson, of the Alta District Gas Company, have asked the Reedley trustees to advertise for a gas franchise for sale. The company offers to install a system if given a 25-year franchise.

CLATSKAINE, ORE.—The electric light plant has been purchased by a Tacoma, Wash., company, which will practically rebuild the plant. About $6,000 will be expended in the reconstruction and installation of new machinery.

HONOLULU, H. T.—United States engineers' office, Honolulu, will receive bids for a 70 ft. steel searchlight tower of the Scherzer type, until July 5th. Information may be obtained from Thos. H. Rees, customs house, San Francisco.

SEATTLE, WASH.—The only bid received by the city for $1,700,000 general municipal bonds has been rejected by the council. Bids were asked for $975,000 refunding bonds, $425,000 light extension bonds and $300,000 water extension bonds.

SAN FRANCISCO, CAL.—Luminous arc standards, 55 ft. in height and furnishing from 8000 to 10,000 candle power, will be one of the mediums through which the Panama-Pacific exposition will be illuminated. These lights will be shaded by ornamental banners of canvas eight feet across.

SALEM, ORE.—The State Railroad Commission has given notice of an exhaustive inquiry into all the rates of the Portland Railway, Light & Power Company for electric lighting, heating and power in all the cities and towns in which it operates. The rates to be subjected to the acid test are those now applying in Portland, Salem, Oregon City, Milwaukie, St. Johns, Linnton, Gladstone, Gresham, Lents, Boring, Estacada, Troutdale, Fairview, Oswego, Woodburn, Silverton, Mount Angel and Gervias and the territory served in the vicinity of these towns by the company's lines.

TRANSMISSION.

HOLTVILLE, CAL.—It is reported that a proposition is under consideration providing for the Holton Power Company building a power line from Imperial valley into Coachella valley.

CLEAR LAKE, CAL.—The Power and Irrigation Company filed a suit in the United States District Court to condemn lands in T. 12 N. and 7 W. and 13 N. and 7 W., for a dam site near the outlet of Clear Lake, the object being to convert the body of water into a reservoir for irrigation and power purposes.

TACOMA, WASH.—The city has started construction of 20 miles of pole line to connect the present double line with the distributing station in the city. Ten miles of this line has been constructed from the headworks, paralleling the line already in existence, which will be transferred to the new pole line.

SPOKANE, WASH.—Mining men of Coeur d'Alene anticipate that within 18 months the Montana Power Company, now preparing to erect a power plant at Thompson Falls, Mont., will invade the Coeur d'Alene District in competition with the Washington Water Power Company, which now furnishes power to practically all the operating mines in that locality.

OROVILLE, CAL.—That the Oro Electric will probably resume construction work on its plant at Humbug within the next 60 days was the statement of R. L. Van Der Naillen, general manager of the company. Van Der Naillen states the many small difficulties, which forced a temporary cessation in the construction work, have been surmounted, and when work is started once more it will go to a successful completion.

SEATTLE, WASH.—H. A. Eastman of Seattle has offered to that city a power project on White River for the sum of $250,000. It is claimed that it is capable of producing 100,000 h.p. at much less cost than either the Hebb project on the White River, offered to the city at $1,000,000, or the Lake Cushman project offered to the city at $640,000. The council will make examination of same in connection with the Lake Cushman proposal.

HOOD RIVER, ORE.—The Hydroelectric Company of Hood River has been sold to the Pacific Power & Light Company, which operates plants in many towns in Washington and Oregon, for a consideration of $125,000. The property sold includes water rights representing a possible development of 6000 horsepower. The purchase is the amicable outcome of a bitter warfare, both commercial and legal, which has been waged by the two companies for several years.

TRANSPORTATION.

SAN DIEGO, CAL.—The Los Angeles & San Diego Beach Railway Company has applied to the commission for authority to issue car-trust notes to the amount of $28,000.

SAN FRANCISCO, CAL.—The finance committee of the supervisors has recommended an appropriation of $5000 for the use of the city engineer for drawing the detailed plans and specifications for the proposed new electric railways.

VALLEJO, CAL.—That the Napa Valley electric line is endeavoring to enter the Benicia field is the statement by those who are in a position to be authorities. It is stated that President Irvine himself is interested in this extension. His idea is to have a connecting link from Vallejo, which will bring this city close to the Oakland-Antioch line.

SAN FRANCISCO, CAL.—The Southern Pacific Company has applied to the railroad commission for authority to issue $30,000,000 5 per cent collateral trust notes. The notes are to be dated June 1, 1913, and will be subject to redemption at par with interest on June 1, 1913, and December 1, 1914, upon 30 days' notice. Of this amount, about $3,000,000 will be spent on the transbay electric and ferry system.

SAN FRANCISCO, CAL.—The construction of the western extension of the Geary street railroad is proceeding with due celerity. The Healy-Tibbitts Company has already laid the ties and rails of the double track from Geary street and Thirty-third avenue, to the beach, and now has to fill in and macadamize the roadbed. The J. G. Sutton Company, which has the contract for the overhead construction, has completed its work, with the exception of stringing the trolley wires.

FRESNO, CAL.—The Fresno Traction Company, through F. E. Cook, has applied to the supervisors for a franchise over the county road, a distance of three-quarters of a mile north of the corner of Wishon and McKinley avenues, for the new line to be built to the San Joaquin River. While the total length of the line will be about ten miles, this three-quarters of a mile will be the only portion that does not go over private right of way, deeded to the traction company. The preliminary survey for the new road is practically completed.

OAKLAND, CAL.—"There is absolutely no truth to the report that the Oakland & Antioch has surveyors in the field for a line from Sacramento to Colfax," said Samuel Naphthaly, representing the Oakland, Antioch & Eastern Railroad. He spoke in answer to the published report that Oakland and Antioch men are busy north of this city, surveying a line to connect the Nevada County Narrow Gauge Railroad, recently purchased by the Oakland-Antioch with the terminus of the regular line from the bay here.

SAN FRANCISCO, CAL.—The public utilities comimttee of the supervisors has fixed August 26th as a tentative date for the election for the $3,500,000 bond issue for municipal railway extensions. This is subject to the approval of the supervisors. It was practically decided also that the interest rate shall be 5 per cent and that part of the issue shall be in $100 and $500 denomination so that the city treasurer may be able to sell a large proportion of the offering over the counter to small investors.

TELEPHONE AND TELEGRAPH.

ALTURAS, CAL.—An application has been made by the Dent Telephone & Telegraph Company to the board of supervisors for a franchise to operate a telephone and telegraph system from Ft. Bidwell to the state line of California and Oregon. Sealed bids will be received up to July 21st for the sale of the franchise.

SAN FERNANDO, CAL.—Transfer of business of Maclay Rancho Water Company to the Consolidated Securities Company has been completed and the latter company is now in complete control of local telephones and water systems. Among the improvements contemplated is the erection of a new telephone exchange building.

RICHMOND, CAL.—The installation of a fire alarm and police telegraph system covering the entire city at a cost of $28,500 has been ordered by the city council and the clerk has been authorized to sign a contract with the Gamewell Fire Alarm & Telegraph Company for the installation of a system according to the plans and specifications submitted.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company within the jurisdiction of the State of California has been notified by the State Board of Railroad Commissioners to appear before the commission June 27 and explain why rates and charges in the interchange of telephone service in the state should not be regulated.

WATERWORKS.

CAMPBELL, CAL.—The Campbell Water Company has applied to the commission for authority to issue $25,000 in stock, representing the investment of new capital in the business.

OLYMPIA, WASH.—The city council has passed an ordinance calling for an election July 21 on the question of bonding in the sum of $150,000 to construct a municipal water system.

MONTEREY, CAL.—The Carmel Development Company has sold the Carmel Water Works to the Monterey County Water Company. The system will be entirely remodeled and improved.

OXNARD, CAL.—A contract for the construction of a municipal water system has been let for $89,815 to C. D. Vincent of Oakland and H. N. Tracy Company of Los Angeles on combined bid. Work will begin at once.

OAKLAND, CAL.—The supervisors have called a special election for July 29th to submit to voters the proposition of organizing a water district including Oakland, Berkeley, Alameda, Emeryville, Albany, Piedmont and San Leandro.

MILWAUKIE, ORE.—The city will not purchase the two water plants, the Fisch plant and the Minthorn Springs, but will sell the $20,000 water bonds and proceed to erect a new plant. The bonds carry 5 per cent interest and run twenty years.

PORTLAND, ORE.—Plans are being prepared by Louis C. Kelsey, consulting engineer, for a complete water system to be installed at Amity, Ore. The plant will consist of a pumping plant and distributing system. The work is estimated to cost $25,000.

SAN FERNANDO, CAL.—The Consolidated Securities Company, which recently acquired the domestic distributing water system of Maclay Rancho Water Company, has submitted a proposition to the board of trustees to sell the water plant to the city for $50,000.

RIVERSIDE, CAL.—The bid of the First National Bank of Riverside for $600,000 worth of municipal water bonds was received and accepted by the city council. The purchaser also took an option for four months on the remainder of the $1,600,000 issue. The domestic water plant of the Riverside Water Company will be taken over by the city with the proceeds of the bond sale.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has applied to the commission for authority to purchase certain water rights, flumes, etc., from the United Water and Power Company in the vicinity of Gold Run, Placer county. The water and flumes are to be used by the Pacific company in connection with its power projects on the Bear River canal.

ALPHABETICAL INDEX TO ADVERTISERS

WHERE TO BUY IT IN THE WEST

FOR ADDRESSES SEE RIGHT HAND COLUMNS

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"Smith-Valle," Moore & Co., Chas. C.

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Manhattan Elec. Supply Co.
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Western Electric Company

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Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
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Asbestos, Wood
Johns-Manville Co., H. W.

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American Ever-Ready Co.
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Dean Electric Co.

Batteries, Dry
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Edison Storage Battery Supply Co.
Electric Storage Battery Co.
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Batteries, Wet
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Fairbanks, Morse & Co.
Keystone Boiler Works
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Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

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Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Pass & Seymour, Inc.
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
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Coils, Armature
D. & W. Fuse Company
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Westinghouse E. & M. Co.

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Kellogg Swbd. & Supply Co.
Westinghouse E. & M. Co.

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Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct," National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

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Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
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Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

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General Electric Company
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General Electric Company
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Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
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Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

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Fort Wayne Electric Works

Dynamos, A. C.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
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Dynamometers
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Fairbanks, Morse & Co.
Moore & Co., Chas. C.
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Westinghouse Machine Co.

Engines, Oil
Fairbanks, Morse & Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
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Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

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San Francisco, 503 Market

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San Francisco, 60 Natoma

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San Francisco, 301 Front
Los Angeles, 355 E. Second

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San Francisco, 156 Second

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San Francisco, 444 Market

Edison Storage Battery Supply Co.
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Egan, A. T.
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San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
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Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

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San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
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Spokane, Wash., Paulsen Blg.

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Los Angeles, 119 E. 7th
Seattle, 1518 1st Ave. So.

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San Francisco, 807 Mission.
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holophane Works of G. E. Co.
San Francisco, Aranson Bldg., 3rd and Mission Sts.

Fuse Boxes
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General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Fuses, Miscellaneous
General Electric Company
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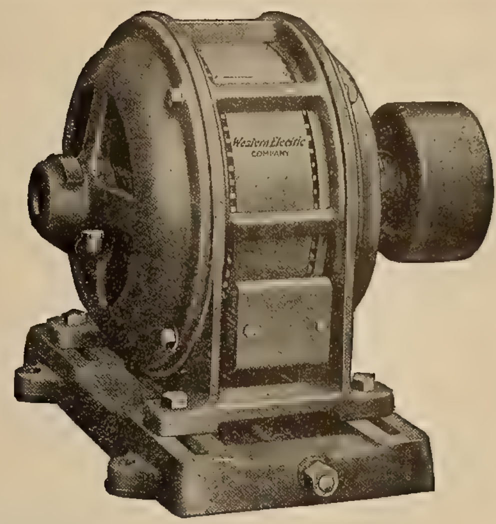

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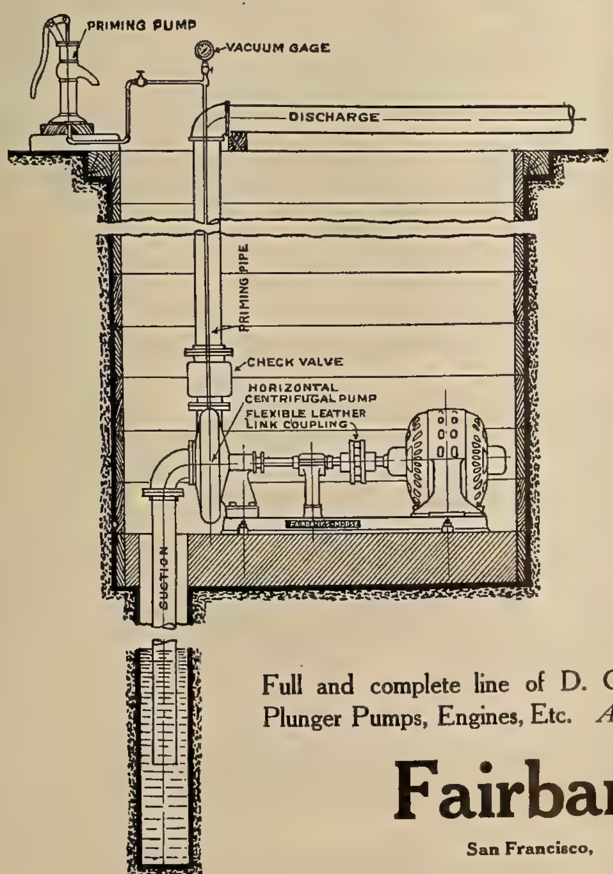

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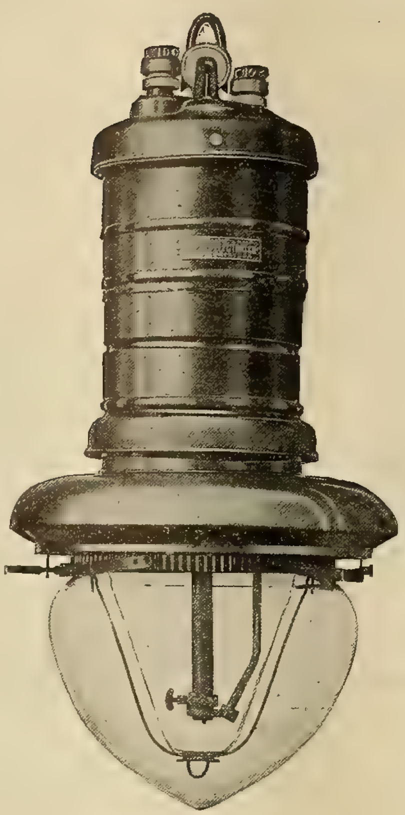

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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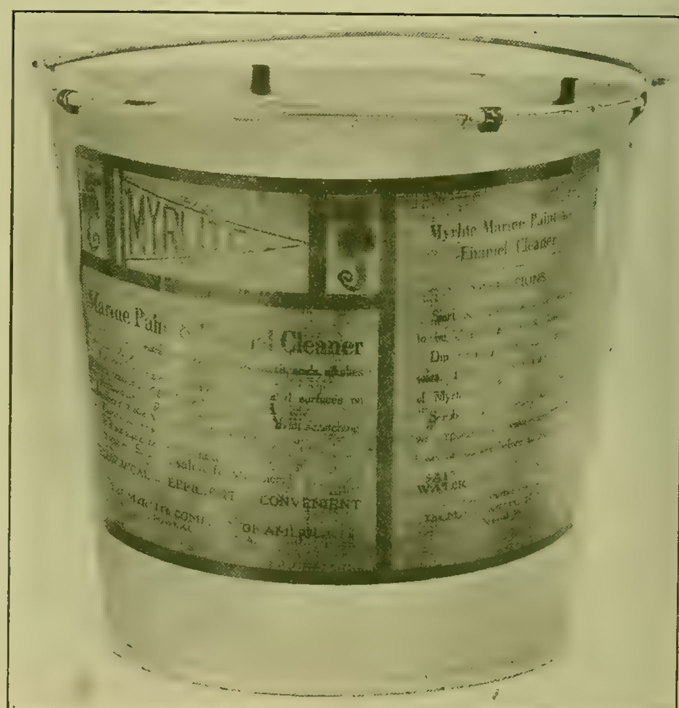
Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**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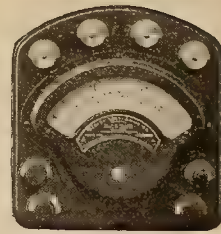

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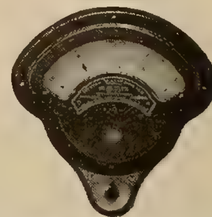

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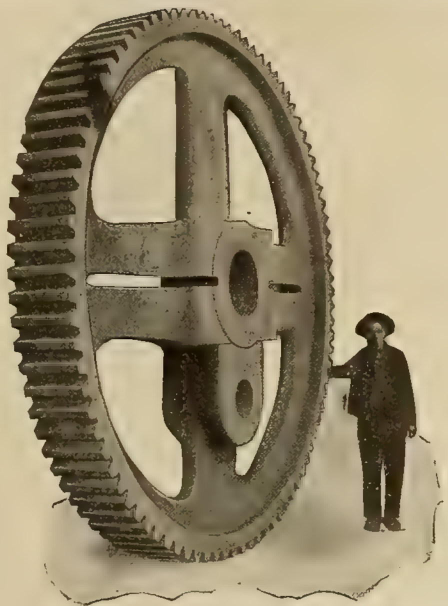


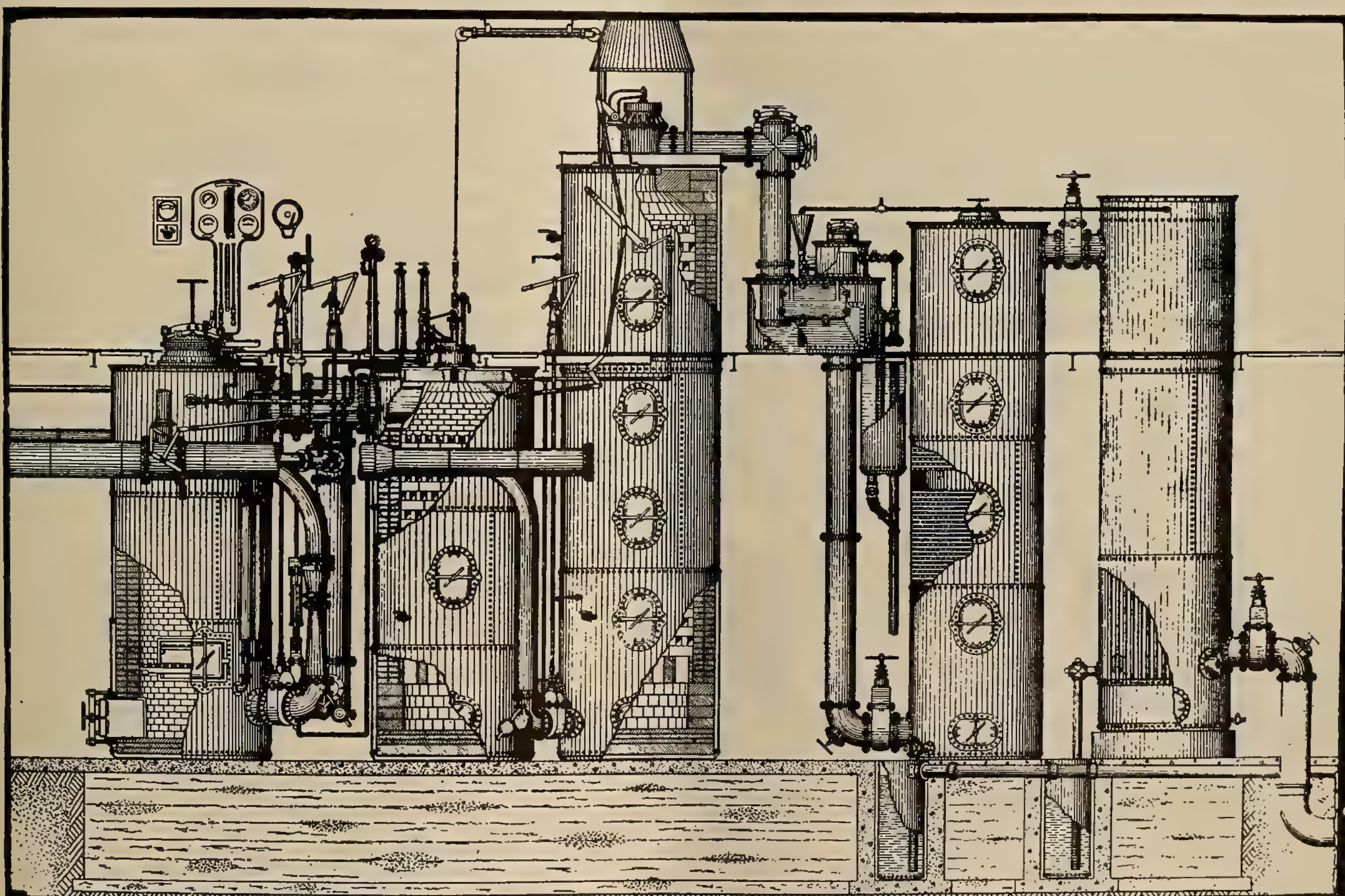
JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX | SAN FRANCISCO, JUNE 21, 1913 | NUMBER 25

THE MANUFACTURE OF WATER GAS

BY E. C. JONES.

Since 1784 when Cavendish discovered that hydrogen was one of the components of water, the decomposition of water has been studied by chemists in the laboratory, and gas men have striven to make practical use of their experiments to cheapen the cost of producing gas. From the time that Lavoisier passed steam through a red hot tube containing charcoal and obtained an inflammable gas, until the advent of the internally fired generator, the work of the inventor was along the lines of the first discoveries, which comprised the dissociation of steam by contact with heated carbon contained in externally heated retorts. The processes were numerous, the theory of water gas was recognized, and its desirability as a substitute for coal gas was admitted, but every effort was a commercial failure.



Standard Double Superheater, "Lowe" Water Gas Set.

It required the mind of a genius to grasp the theory of water gas, and develop it along original lines. This was the work of Prof. T. S. C. Lowe, who in 1872 invented the internally fired generator, used in connection with a superheater filled with refractory material, and made use of secondary combustion for heating the material. Professor Lowe was the "Father of Water Gas." His discoveries were revo-

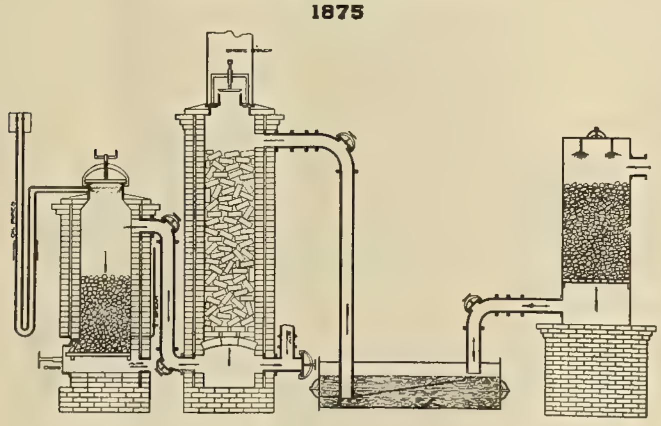
lutionary, and the work of his predecessors hindered rather than helped him to achieve his great success.

The first water gas plant was built and started by Prof. Lowe in February, 1874, in Phoenixville, Penn., and this was the beginning of a new era in the gas industry.

The greatest builders of water gas apparatus in the world describe the Lowe patents of 1872 and 1875 in these words:

"The basic principles involved were the use of a generator and superheater, both shells lined with fire brick; the former being provided with grate bars, air blast and steam connections; the latter being filled with loosely piled checker brick to give fixing surface. In the generator, non-luminous water gas was produced by the dissociation of steam in contact with carbon (in form of anthracite coal), previously heated to incandescence by means of a forced blast of air. The superheater was brought to a suitable temperature for breaking up and fixing oil vapors by the combustion within it of the carbonic oxide formed during and by the passage of the air blast through the fuel in the generator. Oil, or oil vapors were introduced into the superheater coincident with the generation of the non-luminous water gas in the generator, and by contact with the heated fire brick surfaces the oil vapors were gasified and fixed, in the presence of the non-luminous gas and during their passage together through the superheater. The process is, necessarily, intermittent; first a period of blasting to bring the carbon in the generator to the proper temperature, and by complete combustion of the blast gases in the superheater to bring the checker brick to the proper temperature for fixing the oil vapors; second, a period of gas production."

FIRST FORM OF LOWE WATER GAS APPARATUS 1875



This invention is the basis of all forms of water gas apparatus now in successful use and an eminent gas engineer in discussing the subject is recorded as saying: "The credit for the invention of the process whether considered chronologically, practically or legally, belongs unquestionably to Prof. T. S. C. Lowe."

The best preparation for a comprehensive knowledge of water gas, is a careful study of the principles of combustion. Water gas, sometimes called "blue gas" because it burns with a non-luminous flame, is made by the decomposition of steam in the presence of incandescent carbon.

To get carbon in this condition it is necessary to place some form of carbon, usually anthracite coal or coke, on a grate in a simple form of generator. This fuel is ignited and could be raised to the desired temperature by natural draft, but this would be too slow.

To economize time and energy, a forced blast of air is applied to the fuel, the air entering below the grate. Air consisting of oxygen and nitrogen impinges on the heated surface of carbon, and the oxygen unites with the carbon to form CO_2. If the amount of air is excessive and the fuel bed is shallow, the reaction ends here and the fuel is burned to ash, but if the air supply is regulated and the fuel bed is deep, the temperature of the carbon is raised and a further reaction takes place, $CO_2 + C = 2CO$. This is generator gas, and is commercially called producer gas.

This gas issuing from the top of the fuel bed is met by a secondary air blast and the CO is burned to CO_2 and the resultant heat is stored in the checker brick to be used for vaporizing oil.

The nitrogen in the air is inert and plays no active part in the heating process. Prof. Lowe aptly called nitrogen "a thief of heat."

The generator gas always contains a small amount of hydrogen due to the moisture in the fuel, and to the use of steam under the grate bars during the blowing period. A small amount of steam used in this way increases the heating value of the generator gas, and at the same time protects the grate bars and prevents the formation of clinker in the fuel bed.

The incandescent carbon is now ready to dissociate steam. During the blasting period the final products of combustion pass out into the atmosphere through a stack valve. After the air blast is shut off this stack valve is closed and the only outlet from the apparatus, for the escape of gas, is through a wash box provided with a dip-pipe and hydraulic seal.

To make gas, steam is admitted below the grate bars and passing upward comes in contact with the heated carbon.

$$\text{(Carbon) } C + H_2O \text{ (Steam)} = CO + H_2.$$

This would be ideal water gas containing 50 per cent hydrogen and 50 per cent carbonic oxide, but conditions are never perfect and some CO_2 is formed. There are also small percentages of marsh gas, oxygen and nitrogen in the water gas. A typical analysis of the blue gas would be about as follows:

$CO =$	39.75
$H_2 =$	50.00
$CH_4 =$	2.20
$CO_2 =$	4.60
$C_2 =$	.35
$N_2 =$	3.10
	100.00

This gas contains 322 British thermal units per cu. ft.

If it were possible to produce ideal blue water gas by dissociating steam in the presence of incandescent carbon, 1000 ft. of the gas would consist of 500 cu. ft. of hydrogen and 500 cu. ft. of carbon monoxide.

Twenty-four pounds of water would be required to produce the 500 cu. ft. of hydrogen, which would weigh 2.66 pounds, and 250 cu. ft. of oxygen weighing 21.34 pounds.

Sixteen pounds of carbon would produce 500 cu. ft. of carbon vapor that combines with the 250 cu. ft. of oxygen producing 500 cu. ft. of carbon monoxide.

This perfect gas would have a specific gravity of .531 and 1000 cu. ft. would weigh 40 pounds.

When steam is passed through a body of highly heated carbon, the composition of the gas generated varies with the temperature of the carbon, the rate of flow and quantity of steam and the depth of the fuel bed. At temperatures about 1100 degrees F. the reaction is $C + 2H_2O = CO_2 + 2H_2$, the amount of carbonic oxide being very small. When the temperature of the carbon exceeds 1800 degrees F. the reaction is nearly $C + H_2O = CO + H_2$. The following table shows the percentage composition of gas produced by passing steam through carbon heated to different temperatures:

* Temp of Carbon.		Hydrogen. Per ct.	Carbon dioxide. Per ct.	Carbon monoxide. Per ct.
600° C.	1120° F.	66	30	4
700° C.	1292° F.	65	29	6
800° C.	1472° F.	62	23	15
900° C.	1652° F.	54	7	39
1000° C.	1832° F	50	2	48

*Thorpes' Dictionary of Applied Chemistry.

Water gas made in the generator as described is non-luminous, and almost without odor, and it must not be confounded with the same gas after it has been carburetted and has illuminating power and an odor as pronounced as that of any other illuminating gas. The name "blue gas" is used to distinguish this gas from the finished product, and manufacturers invariably speak of the finished product as carburetted water gas. Unfortunately water gas was not immediately accepted by the coal gas companies, and the only way it could get a footing was by competition in the lighting business. This was considered piracy by the old gas companies, and while the name "water gas" was an excellent advertising feature, giving an impression of cleanliness and cheapness, it was subject to attacks on the ground that it was poisonous and without odor. The antagonists of water gas did not differentiate between water gas which is a poor heating gas with no illuminating power, and carburetted water gas which has both high heating and illuminating value.

A ton of anthracite coal in the generator produces about 40,000 cu. ft. of blue gas, and the blasting process to get the coal in condition to dissociate steam yields about 150,000 cu. ft. of producer gas having a heating value of something less than 100 B.t.u. per cu. ft. If this producer gas is wasted, the process cannot be a commercial success for the blue gas contains only about one-half of the heat units of the carbon from which it was made. It was the useful application of the producer gas to the heating of checker brick contained within the same apparatus that solved the problem of economical carburetted water gas making.

Contemporaneous with the experiments of Lowe other inventors were engaged in the work of designing apparatus for the manufacture of non-luminous water gas and carburetting it in a separate apparatus.

The most notable of these was the Tessie du Motay system, first installed for gas making at the works of the Municipal Gas Company of New York in 1876.

In this apparatus the blue gas was made in the usual form of simple generator called a "gasogene" consisting of a fire brick lined shell, provided with a grate on which rested a bed of fuel. The process included blasting the fuel and wasting the products of combustion into the atmosphere, and then passing steam through the heated fuel bed thus forming non-luminous water gas. This gas was conducted out of the gasogene to a carburetter containing pans of naphtha heated to a vapor by steam. The gas enriched by naphtha vapor and carrying it in suspension, was then conducted to a series of heated retorts where the gas was "fixed" or made into a permanent gas. This process for making gas was wasteful in its method of generating the blue gas, and it is obvious that the carburetter and retorts required heating by means entirely independent of the generator fuel. The du Motay process is mentioned here to emphasize the importance of the discoveries of Lowe.

In the modern water gas works all the fuel for gas making is used in the generator, and the only secondary fire is under the boiler for producing steam; this is necessary in any kind of gas works.

In studying the reactions which take place in a water gas generator, there is apparently a sacrifice of heat in converting carbon to carbon monoxide when compared to the results obtained by burning the carbon directly to carbon dioxide, and many attempts have been made to supply non-luminous water gas to consumers to be used as fuel gas or by the use of incandescent gas burners for illumination.

In every instance these ventures failed because the non-luminous water gas containing about 300 B.t.u. per cu. ft. cannot compete with the poorest illuminating gas that is made and distributed. It is now an accepted fact that free hydrogen is not the most desirable element in a fuel gas, and that mixtures of hydrogen and carbon monoxide never contain over 350 B.t.u. per cu. ft., while a satisfactory gas to be used for all purposes should contain at least 500 B.t.u. per cu. ft.

This completely eliminates non-luminous water gas in the consideration of a gas suitable for distribution as fuel for domestic use in the present state of the art. As recently as 1898 there was a revival of interest in blue water gas when Carl Dellwik invented improvements in its manufacture which briefly consisted in using the simplest form of generator with a shallow fuel bed. The air blast is increased in volume and velocity, so that the blast period is reduced to about three minutes. In this way the combustion of carbon is complete, and the products of combustion consist of CO_2 and N_2. Steam is introduced below the grate bars passing up through the fuel, and is dissociated into blue gas and in each alternate run the steam is admitted above the bed of fuel, passing downward through it. This method of operating is known to gas men as up and down runs.

It is claimed for the Dellwik process that the water gas produced utilizes 79 per cent of the fuel carbon. This gas is well adapted to metallurgical work, but for domestic lighting, heating, and cooking, it is necessary to carburet the gas in a separate apparatus using additional fuel to obtain the necessary heat. The du Motay antedated the Dellwik process by over twenty years, and the writer has often wondered if the eminent gas engineer under whose supervision the du Motay plant was operated in New York in 1876, did not discover and make use of all the advantages claimed for the Dellwik process.

Having described the generation of the non-luminous water gas, the next step is to carburet the gas for the purpose of giving it illuminating power and increasing its heating value.

The early Lowe apparatus consisted of a generator connected at the top by a pipe leading to the base of a superheater. The superheater is a fire brick lined shell, longer than the generator and filled with brick thrown in loosely. At the bottom of the superheater, secondary air is admitted for combustion of the generator gas for heating the brick. After the generator fuel has been blasted to the desired heat, and the bricks in the superheater are at the required temperature, the air blast is shut off and the stack valve is closed. Heated oil is then sprayed into the top of the generator above the fuel bed, and mingling with the blue gas passes with it into the superheater. In its passage through the superheater in contact with the heated brick, the oil is vaporized and then converted into a fixed oil gas. At the same time it is thoroughly mixed with and becomes a part of the blue gas. This is called carburetted water gas. In the early days of water gas, naphtha was used for carburetting and the apparatus was designed for its use.

There was then little demand for naphtha and it was the only product of the distillation of crude petroleum for which there was little use, and which the oil refiners found it difficult to get rid of. This new use for naphtha opened a field for the disposal of an unwelcome product. Water gas of 23 candle power required about five gallons of naphtha per thousand cu. ft. for enrichment. The increasing cost of naphtha compelled gas manufacturers to look for a substitute, and by improvements in pre-heating oil and in the methods of using it, the crude oils of Ohio came into use. The crude oils of the eastern states have a paraffin base, and their value for refining is so great that it makes the cost of these oils for water gas enrichment prohibitive.

The oil now used for carburetting water gas is a by-product in the distillation of crude oil, for which there is little demand for other purposes. This is known as "gas oil." The crude oil of California, with its asphaltum base, is unattractive to refiners, but is well suited to the carburetting of water gas. Probably the first improvement in water gas apparatus was the use of "checker brick" in the superheater. This consisted in arranging fire brick in regular rows on edge, and spaced about two inches apart. Each course of brick being at right angles to the course next above and below it. This regular arrangement superceded the use of loosely piled brick and has many advantages over the old way. Checker brick may be heated more uniformly, are not so liable to become clogged with carbon, and are easier to keep clean.

Many forms of water gas apparatus embodying the essential features of the Lowe invention found favor with some of the gas manufacturers both east and west. Among these was the Springer process, whose distinguishing feature was a generator and superheater entirely enclosed in a single shell. The checker brick being sustained by arches above the fuel bed. This was the type of apparatus first installed for water gas making in San Francisco. Among the advantages claimed for this method was economy of fuel.

The most important improvement in water gas apparatus was the addition of a second superheater. This was done by the United Gas Improvement Company of Philadelphia, and the improved set is known as the "double superheater apparatus" which has become the standard in water gas practice.

In this apparatus the first superheater is known as the "carburetter" and the heated oil is admitted to the top of the carburetter instead of the top of the generator as in the earlier form, when it was the practice to introduce oil in four streams. The oil and blue water gas intermingle and pass through the carburetter and the second superheater and are permanently fixed. The double superheater affords a much greater surface of heated brick for fixing the gas than the single one, and both the carburetter and superheater are heated by the products of partial combustion of the fuel from one fire bed.

The use of the two superheaters permits a range of temperatures which would not be possible in a single superheater, and it is therefore possible to successuflly use oils of different densities and of complex compositions.

The material used for water gas manufacture is governed by local conditions. In the eastern states anthracite coal is the best form of carbon for generator fuel, but when water gas is made as an auxiliary to coal gas, it is economical to use gas coke for this purpose.

In California an anthracite coal imported from Swansea, Wales, was first used, mixed with English oven coke, until it was discovered that there was no advantage in using mixed fuels, and Welsh anthracite was used alone. During periods when the supply of gas coke exceeded the demand this coke was also used in the water gas generators of Pacific Coast cities.

The following analyses will give an idea of the relative composition of these fuels:

	Moisture.	Volatile matter.	Fixed Carbon.	Ash.	Sulphur.
Pennsylvania anthracite..	2.98	3.38	87.13	5.86	.65
Welsh anthracite	2.25	6.01	89.84	1.20	.70
Colorado anthracite	3.42	8.76	78.87	8.30	.65
Connellsville coke (oven)	.88	.67	87.05	10.60	.74
Gas coke	3.50	....	87.05	7.50	1.95

When water gas was first made on the Pacific Coast the only available oil was a distillate of 38 de-

grees B., which cost $3 per barrel. This was afterwards supplanted in the larger cities by an excellent quality of crude oil of 36 degrees B. brought from Peru. Then comes the wonderful oil discoveries in California, including the crude oil from Coalinga, this, with distillates from other crudes provided good enriching material at moderate cost.

The only water gas now made on the Pacific Coast is in the largest plants where there is an excess quantity of lamp black, which is a by-product of oil gas manufacture.

This lamp black may be used in bulk in its crude state, or better, made into briquettes depending on its own volatile matter as a binder. This fuel is used in an ordinary water gas generator in the same way as coal or coke, excepting that the blast pressure is considerably less. The pressure of air for blasting rarely exceeds nine inches of water. The ordinary crude oil of 14 degrees B. with asphaltum base is used for carburetting with fairly good results.

After carburetted water gas leaves the set, it passes to a wash box containing a hydraulic seal to prevent the return of the gas to the generator, it is then scrubbed and condensed for the purpose of reducing the temperature and removing tar in a manner similar to that employed in coal gas manufacture.

As water gas contains no ammonia, the scrubbing of the gas is simple and it is not customary to save the water used from scrubbing, unless through scarcity or high price of water it is cooled and used over again. The removal of the tar prepares the gas to be purified. The making of water gas is an intermittent process consisting of the blowing followed by the gas making period, and as gas is made only a portion of the time, it is the practice to conduct the gas from the outlet of the scrubbers to a gas holder, known as a relief holder. This holder acts as a receiver for the intermittent runs of gas and permits the purifiers to be operated continuously. The gas is drawn from the relief holder by an exhauster and is forced through the purifiers and station meter into the storage holder.

Water gas is usually purified by oxide of iron the same as coal gas. The only by-product recoverable from the manufacture of water gas is a small quantity of tar, known as water gas tar. This varies in quantity with the composition of the oil used, and the heats employed to gasify it. The average quantity of tar is about one-half gallon to every thousand cu. ft. of gas.

The following table shows the formation of carburetted water gas using anthracite coal as fuel in its progress through the generator, carburetter and superheater.

*	Top of Generator.	Base of Carburetter.	Middle of Superheater.	Top of Superheater.
Illuminants	.00	10.75	14.75	14.75
Carbon monoxide	39.75	33.05	30.70	30.65
Hydrogen	50.00	43.05	34.60	31.35
Marsh gas	2.20	1.10	12.30	16.75
Ethane (C_2H_6)	.00	5.60	1.45	.30
Carbon dioxide	4.60	4.00	3.70	3.70
Oxygen	.35	.30	.30	.30
Nitrogen	3.10	2.15	2.20	2.20
	100.00	100.00	100.00	100.00

*W. H. Fulweiler.

By the application of skill and the results of scientific research the fuel and oil now used to produce carburetted water gas is reduced to nearly the lowest possible point. At Phoenixville the first gas made required 74 2/3 lbs. of anthracite coal for each 1000 ft. and 4 4/15 gallons of oil for an 18 candle gas. The fuel was high, but the oil was low for the reason that it was thought that water gas with an equivalent of candle power to coal gas would be satisfactory. It was afterwards determined to raise the candle power of water gas for competitive purposes and the amount of oil used was increased to about five gallons per 1000 ft. The specific gravity of coal gas is .435, while the specific gravity of carburetted water gas is .630. The water gas flame is therefore of much less area per candle. An 18 candle power coal gas burned through an open flame burner has the same flame area as a 23.5 candle carburetted water gas flame. Each burner consuming gas at the rate of 5 cu. ft. per hour. As the light emitting surface has much to do with illumination, it will at once be seen why it is necessary to have carburetted water gas of higher candle power than coal gas to produce the same effect.

On the Pacific Coast, using Welsh anthracite coal and Peruvian crude oil in a double superheater apparatus, carburetted water gas of 27.6 candle power was produced with 4.36 gallons of oil and 39.6 lbs. of coal per thousand cu. ft., exclusive of boiler fuel.

A brief statement of the most recently obtained results is taken from a paper read by O. B. Evans at the seventh annual meeting of the American Gas Institute, on the subject of "Heat Balance of a Carburetted Water Gas Set." The tests were made with a 6 ft. Lowe set, erected for experimental purposes, and following are some of the results showing operating conditions:

Coal per 1000 cu. ft. as fired	30.34 lbs.
Fixed carbon per 1000 from analysis	24.42 lbs.
Oil per 1000 ft.	3.84 gals.
Candle power of gas	24.3 candles
Candles per gal of oil	6.33 candles
Average length of blow	3.18 min.
Average blast pressure	21.5 in. of water
Actual length of runs	3.93 min.
Steam per 1000 cu. ft.	32.8 lbs.

The temperature observed during these tests were as follows:

	° F.
Carburetter base	1270
Superheater base	1290
Superheater top	1280
Outlet wash box	187
Outlet exhauster	156
Inlet condenser	155
Outlet condenser	107
Inlet tar extractor	106
Inlet purifier	93
Outlet purifier	88
Outlet station meter	84
Atmosphere	75

It is hoped that this meager outline of a great industry will serve to stimulate a further study of the subject, as an understanding of the refinements of operation in the manufacture of carburetted water gas is a necessary part of a gas engineer's equipment.

THE ECONOMIC STATUS OF THE STREET CAR SYSTEM OF SAN FRANCISCO.

(Concluded.)

BY F. K. BLUE.

The Securities of the United Railroads.

According to Fig. 1, (taken from the Report of Bion J. Arnold, Fig. 20) the actual investment of the United Railroads in 1902 was about $17,000,000, to which about $11,000,000 was added in betterments during the next ten years. At 6 per cent interest, the present value, as of 1912, of this investment is $30,400,000, and of the betterments $16,700,000, making a total of $47,100,000, as the present value of the actual investment in the properties of the United Railroads. Computed from the data given in Table 41, the present value of the net earnings for the ten years from 1902 to 1911 inclusive amounts to $35,160,000. Adding $21,000,000, the assumed present depreciated value of the property, gives $56,160,000 as the present value of all the past resources of the property. The difference between the present value of the total investment and the present value of the total return amounts to $9,060,000, which may be regarded as the present franchise value of past income in excess of 6 per cent on the investment. The average interest received on the assumed actual cash investment during this time was according to these estimates about 8.6 per cent, which was certainly not an exorbitant profit in comparison with that often realized from industrial investments.

The following table shows the par value of the outstanding term securities and the stock of the United Railroads:

Park and Cliff House 6% bonds maturing in 1913	$ 350,000
Market Street Cable 6% bonds maturing in 1913	3,000,000
Park and Ocean 6% bonds maturing in 1914	250,000
Ferries and Cliff 6% bonds maturing in 1914	650,000
Omnibus Cable 6% bonds maturing in 1918	2,000,000
Sutter Street 5% bonds maturing in 1918	1,000,000
Market Street Railway 5% bonds maturing in 1924	7,341,000
United Railroads 4% bonds maturing in 1927	23,688,000
United Railroads 5% notes maturing in 1916	1,000,000
Trust certificates 6% maturing in 1918	400,000
1st preferred 7% cumulative stock	5,000,000
2d preferred 4% cumulative stock	20,000,000
Common stock	18,800,000
Total securities	$83,479,000
2d preferred and common stock	38,800,000
Bonds, notes and 1st preferred stock	44,679,000

Since the current liabilities in excess of this amount ($5,685,101 in 1910) roughly equals the current assets in excess of that covered by the physical property and franchise values, it may be assumed that the par value of these physical and franchise values of the property is practically represented by the total par value of the above securities, $83,479,000. The market value of these securities cannot be directly estimated since it depends upon the market value of the securities of the holding company, which also holds other securities, but it may be roughly considered as lying somewhere in the neighborhood of $50,000,000 to $60,000,000, which compares well with the present value of the estimated total income to the expiration of the franchises.

The present value of the interest which has been paid on the $44,679,000 of bonds, notes, and first preferred stock amounts to $24,340,000, and the present value of the cash dividends which have been paid on the second preferred and the common stock is $4,000,000, which added together makes $28,500,000, as the present value of the past cash payments to the security holders. If the balance of the earnings were invested in the betterments made during this time it would be economically equivalent to cash payment to the security holders, since it saves them that much on the investment necessary to keep the property in a condition to yield its income.

Turning now to the future, the present value of all the obligations incurred by the bonds, notes and first preferred stock for 40 years, until the last franchise expiration, amounts to $37,430,000. This includes all interest payments and liquidation at par at maturity with the exception of the 4 per cent U. R. R. bonds which are assumed to be liquidated at 60 per cent of par value (assuming a present value of about 64 per cent of par), since their present market price indicates that they partake of the nature of stock in that investors do not now expect them to be liquidated at par. Subtracting $5,060,000, the present value of future betterments, from $56,430,000, the present value of future earnings from operation for maximum profit, leaves $51,280,000 as the present value of the future earnings that may be credited to the present investment. Taking $37,430,000 from this leaves $13,850,000 as the present value of the amount that can be distributed to the second preferred and the common stock. This is 35.6 per cent of its par value, and would afford quite a profit to the holding company.

If the franchises are operated under reasonable service conditions there would be a present value of only about $2,030,000 left for the second preferred and the common stock, but a comparison of the probable earnings with all the other accruing obligations shows that in either case there would always be a considerable margin of earnings except for the years 1913 and 1914, when there would be a deficit on account of the maturity of $350,000 of Park and Cliff bonds and $3,000,000 Market Street Cable bonds.

Operation Under the Self-Adjusting Rate Fixing Method.

If the whole street car system were operated by the United Railroads according to the self-adjusting rate-fixing method described in this journal for November 30, December 7, April 26, and May 3 the total earnings would, under the conditions assumed, be distributed between the company and the city in about the same proportion as under the resettlement plan. The chief difference in the practical working of the two plans would be that under the self-adjusting method an excess in earnings above the amount now assumed would go to the city and a deficiency would allow more to go to the company in order that the company should be assured an income corresponding to the profit that the public is willing to accept for an investment in its securities, provided such amount is available out of the gross earnings. Earnings might prove to be considerably different from what can now be estimated, either on account of difference between actual and estimated population or on account of economic or industrial changes causing the relative cost of operation to be different from what it is at present. In the self-adjusting method all such changes

are automatically accounted for when they occur, so that a distribution of income based on a present estimate of future conditions is thereby avoided.

In carrying out the self-adjusting method the present value of the investment would first be established. Then the investment for each succeeding year would be the value of this investment with the betterments added and the depreciation subtracted.

The required net earnings for each year would be found by multiplying this investment by the acceptable rate of interest on investment as determined by the market value of the securities during the previous year and adding the estimated amount of depreciation. Errors in estimates of depreciation would be corrected in succeeding years since the original investment plus the accumulated betterments minus the accumulated depreciations should be made to equal the value at which the property could be liquidated as in place, which could be checked by appraisal at any time. Small errors in the exact time at which a given depreciation increment is liquidated by being added to required net income would make practically no difference in the final result, since the loss in annual income suffered by the city from deferred liquidation of depreciated investment would be balanced by a gain due to the deferred year in which the income of the city is reduced by the payment of the depreciation value to the security holders.

In order to arrive at the nominal car fare, the required net earnings is treated in the same manner as the "estimated required earnings exceeding cost of operation, D," described in this journal for April 26; that is, this quantity is added to the estimated operating cost for the year and the sum is divided by the estimated number of revenue passengers, the quotient being the nominal fare required. This nominal fare multiplied by the actual number of passengers gives the nominal gross earnings received during the year.

Proceeding further as described in the article mentioned, we finally come to the "adjusted gross earnings required during the year to pay cost of production and required dividends on the stock, E," which being subtracted from the actual gross earnings from the five cent fares leaves the amount which belongs and is paid to the city. Adjusted in this manner the income received by the company depends also on the efficiency of operation.

The required rate of interest on investment to be used in fixing the estimated required earnings for the succeeding year is determined by dividing the estimated required earnings for the given year (not including depreciation) by the average market value of all the outstanding securities during the given year. This is the essential element of the self-adjusting standard of rate fixing. For it follows that if the market price of the securities is too high the quotient of the required net earnings previously established for the year divided by the market price of the securities will be relatively small, and consequently the required rate of interest on the investment and therefore the income for the succeeding year will be relatively low, which will in turn cause a reduction in the market value of the securities, and vice versa. This governing effect of a high market price of securities causing a reduction of income, and a low market price causing an increase in income will automatically cause the market price of the securities to approximately equal the value of the investment at all times in precisely the same manner that a governor by varying the supply of steam causes the engine to run at an approximately constant speed under varying changes in load.

The present value of the amounts of the total estimated earnings divided between the company and the city has been computed on the same basis as before and is shown in the table. The apparent agreement of the $21,320,000 going to the city under the self-adjusting method with the $21,380,000 going to the city under the resettlement plan is adventitious, since if any other rate than 6 per cent had been assumed as the required rate of interest on the investment under the self-adjusting method, these values would have differed correspondingly.

The fundamental principle thus recognized and carried out by the self-adjusting method of rate fixing is that a public service corporation is entitled to an interest on its investment equal to what is acceptable by the public who invests in such securities and that any surplus income above this comes under the category of "unearned increment" and belongs to the public. The self-adjusting method allows extensions and betterments to be made at will to conform to the requirements of efficient service, yet automatically preventing a dollar of franchise or intangible value from being added to the investment. Under the resettlement plan contemplated by the proposed amendment No. 34 no franchise value would be added provided the present estimate of future conditions proved correct, but in practice a considerable franchise value would probably be added or subtracted before the end of the 40 years, according to whether the income actually received by the security holders became greater or less than what was acceptable to the public investors in the securities of the company.

ELECTRIC PLANT PROJECTED IN CANADIAN COAL FIELDS.

At Lingan there are some valuable properties not accessible to the railway, and it is proposed by the owners to erect on their property a large electric power plant to supply power for established industries, also for new industries coming to Sydney or vicinity. The new Board of Trade is working for establishment of the ship building plant, a hat factory, traction engine works, and several other smaller industries. With a power plant located in the midst of the coal areas supplying cheap power, the Board of Trade will have a powerful attraction to aid them in building up the industrial life of Sydney. While the establishment of this plant in the coal fields is not fully settled, it is believed that it will be carried through before the summer is over. Information as to the field to be covered and the present status of the project may be obtained of Mr. C. B. Ross, Ross Block, Charlotte Street, Sydney, Nova Scotia.

ELECTRICITY ON THE WESTERN FARM.

The Committee on Electricity on the Farm, Western States, appointed by the Executive Committee of the Commercial Section of the National Electric Light Association, in preparing its report to the 36th Annual Convention at Chicago, June 2-6, 1913, sent out a list of some 150 questions to members' companies in the Western States, Mexico, Hawaii and Japan.

The answers would indicate that the use of electricity for agricultural purposes in the West is more extensive in the States of Washington, Oregon, California and Colorado. The companies operating in the States of Idaho, Nevada, Arizona and Texas, and in Mexico, were very much interested and expect in the near future to get into the subject more deeply. Our conclusion from this is that hydroelectric power and electricity on the farm are close companions. The exception to this is the case of the Northern Colorado Power Company, operating in the northern part of the State of Colorado, the plant in this case being located in the center of the northern coal fields and the power generated by the use of the steam turbines operated with coal as fuel.

The various companies follow practically the same method in so far as construction of lines, voltage, phase, etc., are concerned, the practice being to extend the primary lines to a district at a voltage ranging from 22,000 to 110,000, depending on the area to be served and the load to be handled. Substations are located at points which will become load centers and distribution lines of either 11,000 volts or 2300 volts (either delta or star connected) are run to supply consumers.

In practically every case the consumer was asked to advance the cost of running the distribution lines and to furnish his own transformers when the business was first started and in the experimental stage. Most of the companies have now proven to their own satisfaction that the business is profitable and will support the entire investment of line and transformers, so that the consumer is not asked to pay for anything beyond the motor. This liberal policy has, of course, been the means of making electricity extremely popular, and in many sections it is the rule rather than the exception to see the farmer doing a great part of his work with electricity.

The most interesting thing brought out was the great difference in the method of charging for the power and the amount of the charge. At the end of this report are copies of rate schedules from various companies operating in the different States, showing rates in force for agricultural business.

The use of electricity on the farm is necessarily a seasonal use, the greatest demand being for pumping for irrigation. Depending on the locality and on the crop to be irrigated, the irrigating season under normal conditions is from April to October, inclusive. A dry year, such as has just been experienced in California, will make the season longer. It was a common sight in the Sacramento Valley, in January of this year, to see the alfalfa and sugar beet land irrigated by pumping from the wells. It is very apparent, therefore, that it is to the power company's advantage to have the consumer make his installation as small as possible and operate as many hours per day as possible, in order to cut down the power company's plant investment and increase the return per unit of installed capacity. Some of the rates have been designed with this object in view, notably those of the San Joaquin Light and Power Company.

The members of the committee were: S. V. Walton, H. S. Wells, E. B. Walthall, Frank W. Balfour, A. W. Hahn, F. E. Boyd and C. E. Hardy.

RATES OF PACIFIC GAS AND ELECTRIC COMPANY FOR AGRICULTURAL POWER—GENERAL.

For installations of 5 h.p. and over and less than 30 h.p.:

3c	per kilowatt-hour for first	500 kw.h. per month
2½c	per kilowatt-hour for next	500 kw.h. per month
2c	per kilowatt-hour for next	2000 kw.h. per month
1½c	per kilowatt-hour for all over	3000 kw.h. per month

Minimum charge, $6.00 per h.p. per year.

For installations of 30 h.p. and over and less than 50 h.p.:
2c per kw.h. Minimum charge $6.00 per h.p. per year.

For installations of 50 h.p. and over and less than 100 h.p.:
1½c per kilowatt-hour for all current consumed.
Minimum charge of $6.00 per h.p. per year.

For installations of 100 h.p. and over:
1¼c per kw.h. Minimum charge $6.00 per h.p. per year.

For installations of 100 h.p and over where the consumer expects to irrigate a large tract of land from one central plant:

1c per kilowatt-hour for all current consumed.
Minimum charge. $12.00 per h.p. per year.

RATES OF PACIFIC GAS AND ELECTRIC COMPANY FOR AGRICULTURAL POWER—OPTIONAL.

This schedule applies to installations of 5 h.p. and over.

3.0c	per kw.h. if monthly consumption is less than 30 kw.h. per h.p.				
2.9c	per kw.h. if monthly consumption equals or exceeds	30	kw.h. and is less than	40	kw.h. per h.p
2.8c	" " " " " " " "	40	" " " " " "	52	" " "
2.7c	" " " " " " " "	52	" " " " " "	66	" " "
2.6c	" " " " " " " "	66	" " " " " "	82	" " "
2.5c	" " " " " " " "	82	" " " " " "	100	" " "
2.4c	" " " " " " " "	100	" " " " " "	120	" " "
2.3c	" " " " " " " "	120	" " " " " "	142	" " "
2.2c	" " " " " " " "	142	" " " " " "	166	" " "
2.1c	" " " " " " " "	166	" " " " " "	192	" " "
2.0c	" " " " " " " "	192	" " " " " "	220	" " "
1.9c	" " " " " " " "	220	" " " " " "	249	" " "
1.8c	" " " " " " " "	249	" " " " " "	280	" " "
1.7c	" " " " " " " "	280	" " " " " "	312	" " "
1.6c	" " " " " " " "	312	" " " " " "	346	" " "
1.5c	" " " " " " " "	346	" " " " " "	381	" " "
1.4c	" " " " " " " "	381	" " " " " "	418	" " "
1.3c	" " " " " " " "	418	" " " " " "	456	" " "
1.2c	" " " " " " " "	456	" " " " " "	496	" " "
1.1c	" " " " " " " "	496	" " " " " "	538	" " "
1.0c	" " " " " " " "	538	" " " " "		" " "

Minimum charge, $6.00 per h.p. per year.

The above rate is given only providing the consumer will sign a contract for a term of years, the length of the term depending on the value of the business in proportion to the expenditure necessary to supply such consumer.

RATES OF SAN JOAQUIN LIGHT AND POWER COMPANY.
Rate Schedule of Irrigation Plants.

Period of Year.	Daily Service.	Rate.
1. Jan. 1 to Dec. 31	24 hours	$50.00 per horse-power
2. Jan. 1 to Dec. 31	Daylight hours	36.00 per horse-power
3. Feb. 1 to July 31	24 hours	31.20 per horse-power
4. Feb. 1 to July 31	Daylight hours	22.50 per horse-power
5. Mar. 1 to July 31	24 hours	27.75 per horse-power
6. Mar. 1 to July 31	Daylight hours	20.00 per horse-power
7. Apr. 1 to July 31	24 hours	25.00 per horse-power
8. Apr. 1 to July 31	Daylight hours	18.00 per horse-power
9. May 1 to July 31	24 hours	22.50 per horse-power
10. May 1 to July 31	Daylight hours	16.50 per horse-power
11. June 1 to July 31	24 hours	22.50 per horse-power
12. June 1 to July 31	Daylight hours	16.50 per horse-power
13. July 1 to July 31	24 hours	22.50 per horse-power
14. July 1 to July 31	Daylight hours	16.50 per horse-power
15. Aug., Sept. and Oct., following service stated in Sections 3 to 14	24 hours during Aug. and Sept. Midnight to sundown during Oct	2½c per kw.h. Monthly min. $1 per installed h.p.

The electricity to be paid for during the flat rate period of each year shall be based upon the maximum amount used at any time during that period. All contracts shall be for a term of five years.

RATES OF NORTERN CALIFORNIA POWER COMPANY.
(Rate fixed by Railroad Commission of California.)

Seasonal Power Rates.

Applicable to Small Rural Power.

Normal or Irrigating Season of Six Consecutive Months.

Class "A."

Demand charge: $1.00 per h.p. per month, plus energy charge, one (1) cent per kw.h.

Minimum bill: $2.50 per month, for not less than six (6) consecutive months each year.

Class "B."

Short Season of Three Consecutive Months.

Demand charge: $1.50 per h.p. per month, plus energy charge, one (1) cent per kw.h.

Minimum bill: $5.00 per month, for not less than three (3) consecutive months each year.

RATE SCHEDULE.

For pumping plants where the entire acreage to be irrigated therefrom is not fully planted until one or two years succeeding the date of installation of said plant.

Period of Year.	Rate.	Monthly Minimum.
16. 12 months.	2½c per h.p.-hr.	$1.75 per installed h.p.
17. 9 "	" " "	2.00 " " "
18. 8 "	" " "	2.00 " " "
19. 7 "	" " "	2.00 " " "
20. 6 "	" " "	2.25 " " "
21. 5 "	" " "	2.25 " " "
22. 4 "	" " "	2.25 " " "

The hours of each day the motor may be operated are as follows:

During January from 12:01 a. m. to 4:30 p. m.
" February " 12.01 " " 5:15 "
" March continuously.
" April "
" May "
" June "
" July "
" August "
" September "
" October from 12:01 a.m. to 4:45 p. m.
" November " 12:01 " " 4:30 "
" December " 12:01 " " 4:20 "

The meter rate conditions shall continue for a term of one or two years and shall then be followed by those conditions stated in any of sections 1, 2, 3, 4, 5, 6, 7 or 8 for a further term of five years.

THE TRUCKEE RIVER GENERAL ELECTRIC COMPANY ELECTRIC RATE SCHEDULE.

For Irrigation Purposes:—Power not to be used between the hours of 6 to 11 p. m. daily and only during the months from April to October inclusive of each year. Power to be supplied and metered at 2200 volts or supplied at transmission voltage and metered on the low tension side of consumers high tension transformers.

Term of contract:—Not less than five (5) years.

Minimum:—$3.00 per season per rated horsepower of motors connected.

Rates as follows:—

For first 5,000 kw.-hr. 1.7c per kw.-hr.
For next 5,000 kw.-hr. 1.5c per kw.-hr.
For next 20,000 kw.-hr. 1.3c per kw.-hr.
All excess over 30,000 kw.-hr. 1.2c per kw.-hr.

In addition to the meter rate to pay 50c per month per rated horsepower of motors connected or on the rated installed capacity of the high tension transformers, figured in k.v.a., if they exceed 150 per cent of the rated capacity of the motors.

Discounts:—10 per cent on the above rates where payments are made on or before the 15th of the month next following that for which bill is rendered.

READINESS TO SERVE RATE OF THE NORTHERN COLORADO POWER COMPANY.

A. A kilowatt-hour charge as follows:

First 2,000 kw.-hrs. delivered per mo. at 3.00 cts. per kw.-hr.
Next 2,000 kw.-hrs. delivered per mo. at 2.75 cts. per kw.-hr.
Next 5,000 kw.-hrs. delivered per mo. at 2.50 cts. per kw.-hr.
Next 5,000 kw.-hrs. delivered per mo. at 2.25 cts. per kw.-hr.
All over 14,000 kw.-hrs. delivered per mo. at 2.00 cts. per kw.-hr.

B. In addition thereto a net readiness to serve charge per month during January, February, March, April, May, June, July, August, September, October, November and December as follows:

$1.00 per connected h.p. for each of first 15 h.p. connected.
$0.75 per connected h.p. for each of next 10 h.p. connected.
$0.50 per connected h.p. for each of next 25 h.p. connected.
$0.25 per connected h.p. for each h.p. exceeding 50 h.p. connected.

STRAIGHT METER RATE.

A. A minimum charge per month of $1.00 per connected horse-power or its equivalent.

B. A kilowatt hour charge as follows:
For any portion of

The first 500 kw.-hrs. delivered per mo. at 5.00 cts. per kw.-hr.
The next 500 kw. hrs. delivered per mo. at 4.50 cts. per kw.-hr.
The next 1,000 kw.-hrs. delivered per mo. at 4.00 cts. per kw.-hr.
The next 3,000 kw.-hrs. delivered per mo. at 3.50 cts. per kw.-hr.
Over 5,000 kw.-hrs. delivered per mo. at 3.00 cts. per kw.-hr.

FRENCH IMPORTS IN PETROLEUM.

The growth in the consumption of petrol in France is well shown in the following table:

	Hectolitres.
1908	1,439,593
1909	1,850,753
1910	1,792,481
1911	2.017,974
1912	2,489,305

The sources of supply of all petrol imported are the following, in the proportions given:

	1911 Per cent	1912 Per cent
America	35.2	37.1
Russia	18.9	18.7
Roumania	39.1	36.3
Austria-Hungary (Galicia)	4.7	7.6
Other	2.1	0.3

While America has been steadily increasing her proportion, Russia and Roumania have fallen off during the last two years, the decline of Roumania being marked from 52½ per cent in 1910 (not given in above table) to 36 1-3 per cent in 1912.

ELECTRICAL PUMPING AND IRRIGATION

INVERTED SIPHON CONSTRUCTION.

BY B. A. ETCHEVERRY.

Auxiliaries.

Wasteway and Sand Box. The inlet of a siphon, because of its nearness to a drainage channel, is favorable for the location of a wasteway or overflow spillway. It is desirable to provide a wasteway at the inlet, to be able to turn the water out of the canal in case of a break or obstruction of the siphon, or of a break in the canal below. The wasteway should be designed also as a sand box by forming a depressed basin to reduce the velocity and collect the larger material transported by the water. Where the water is clear and when the velocity in the canal is low compared with the velocity in the siphon, no sand box is necessary.

Anchorage. Anchorage is especially necessary for the convex bends in steel pipe to resist the temperature stresses which tend to lift the pipe. For wooden stave pipes and reinforced concrete pipe no anchorage is generally necessary.

Air outlet valves. Air outlet valves are small valves placed at the summits or convex bends of the siphon for the purpose of automatically letting out air. They are especially necessary where the pressure is low. Where the pressure is considerable it is sufficient to use an ordinary valve which is opened when the pipe is being filled. As a general rule air valves with a diameter of one inch for each foot in diameter of the water pipe are sufficient.

Air inlet valves. Air inlet valves are only necessary for steel pipe. Their purpose is to let air into the pipe to prevent a vacuum and the collapsing of the pipe which would happen when a break in the pipe occurs at a low point allowing a rapid running out of the water. The valve must be sufficiently large to let the air in rapidly, generally the net area should be equal to that of a circle one-eighth of the diameter of the pipe.

Blow-offs. Blow-offs consist of a take out connection or gate placed at the low points of the siphon. The blow-off may be intended:

1. To empty the pipe in case of repair or to prevent freezing in the winter, in which case the diameter may be small.

2. To waste the water and use the blow-off as a wasteway, in which case the discharging capacity should be the carrying capacity of the siphon.

3. To scour out deposited material. This requires a large blow to produce a velocity equal to or greater than the normal velocity in the siphon. It is much preferable to prevent the deposit by using a suitable settling basin or sand box at the inlet.

Examples of Siphons.

The Wolf Creek lateral siphon of the American Beet Sugar Company, Colorado, is used to cross Wolf Creek. The entry and exit chambers are of the same size and same design and are connected with a wooden stave pipe. Both chambers are identical and consist of wing walls leading to and surrounding a rectangular well. A wrought iron screen prevents the falling in or entrance of large material in the siphon.

The Clay Creek siphon of the American Beet Sugar Company consists of an inlet chamber and an outlet chamber connected by means of a reinforced concrete pipe 5 ft. 8 in. in diameter. The inlet and outlet chambers consist of buttressed wing walls leading to and surrounding a vertical well 7 ft. in diameter. The inlet well rests on rock and the outlet rests on soil. Between the two wells is the reinforced concrete pipe 5 ft. 8 in. in diameter, 325 ft. long and 6 in. thick. The inlet to the siphon is regulated by three gates. The whole structure is reinforced with corrugated bars. The wing walls are all of the buttress type. The pipe is reinforced with ½ in. corrugated bars and two old cables 1½ in. in diameter. The circumferential reinforcement consists of hoops made with ½ in. corrugated bars 22 ft. long with the ends tied and lapping 21 in. These hoops are spaced 12 in. from center to center. The longitudinal bars are spaced 15 in. center to center. The inlet and outlet are very substantial structures. The wing walls extend well down below the bed of the canal making the structure safe against undermining. The form used for constructing the conduit is made in two parts, each slightly smaller than a half cylinder. The upper part is separated from the lower part on each side by wooden wedges and a key block to which is fastened a strip of galvanized iron 4 in. wide is inserted to complete the circle.

The M Line Siphon, Umatilla project, Oregon, is used to carry about 70 sec. ft. of water across a depression. The total length is 4680 ft. and the maximum pressure head when the siphon is running at its full capacity is 55 ft. The pipe connecting the entry and outlet chambers is 47 in. inside diameter and 2½ in. thick. The pipe was moulded in advance in sections 8 ft. long, hauled two miles from the pipe yard to the location of the siphon, then laid and joined in the trench as described previously.

The inlet chamber combines the entrance to the siphon and a division gate at right angles, so that the flow may be regulated and divided between the siphon and the other branch. The entry box to the siphon consists of a rectangular box 9 ft. 6 in. deep. The bottom of the pipe is flush with the bottom of the box and the top of the pipe is far enough below the water line to prevent the entrance of air. A wooden screen in front of the inlet prevents the entrance of large material. The inlet and outlet are tapered so as to form a conical entrance. A buttress wall divides the entrance to the inlet box into two openings which are regulated by means of flashboards fitting in grooves made in the sides of the box and buttress wall. The siphon pipe is provided with blow offs at all low points and air cocks at the higher points. The maximum pressure head is about 55 ft. The reinforcement used for the pipe consisted of 5/16 wire and the spacing was

computed for the different pressures for a tensile stress of 12,000 pounds per sq. in. The heaviest reinforcement has a spacing of 1⅝ in.

Inlet to M Line Siphon, Umatilla Project, Oregon.

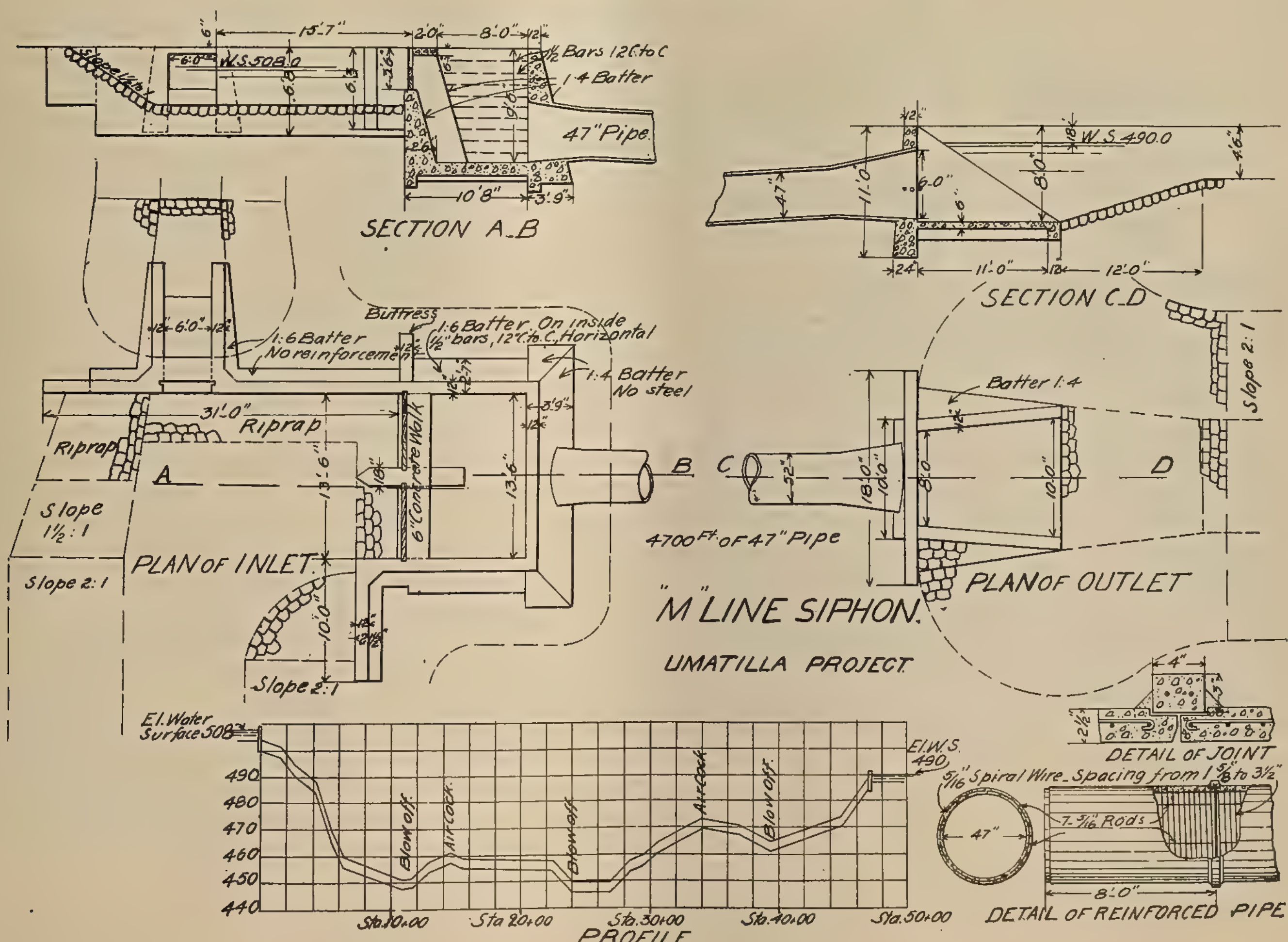
The pipe has been entirely satisfactory although it has been subject to very low temperature, the minimum record being—28¾ degrees F. When first completed tests were made to determine its water tightness. The loss was only ½ gallon per second in the total length of 4700 ft. The cost of the siphon was:

Intake, 58 cu. yds. of concrete	$ 1,019.99
Outlet, 22 cu. yds. of concrete	495.52
Cement pipe at manufacturing plant, 4680 ft. at $3.82.	17,879.53
Hauling, excavation, backfill, joining, painting inside of pipe	5,921.29
Miscellaneous	706.43
Engineering and administration	4,456.38
	$30,479.14

On the Belle Fourche project, South Dakota, three siphons were constructed in the summer of 1908. The Belle Fourche River siphon is 5 ft. inside diameter, 3600 ft. long and has a pressure head of 65 ft., the outlet being 30 ft. lower than the inlet. The Whitewood siphon has an inside diameter of 6 ft., is 395 ft. in length and has a pressure head of about 16 ft. The Anderson siphon is 7 ft. inside diameter, 477 ft. long, with a head of about 70 ft. and the outlet is 5 ft. lower than the inlet.

The siphons are all 8 in. thick and reinforced with square twisted steel bars. The circumferential bars vary in size and spacing according to pressure. The sizes are ½ and ⅝ in. bars and the spacing ranges from 12 in. for the maximum spacing to 4¼ in. The longitudinal reinforcement in all three siphons consists of ½ in. twisted steel bars spaced about 12 in. apart. The twisted steel bars for the circumferential hoops were bent and securely fastened by welding. The longitudinal rods were overlapped 20 in. at the ends and tied with wire. All intersections were wrapped with wire.

The concrete was machine mixed and composed of Portland cement, sand and gravel in the proportion 1 : 2¼ : 3¾, with 20 to 22 per cent of water. One barrel of cement was considered equal to 3.75 cu. ft. The sand was screened to exclude pebbles larger than ¼ in. in greatest dimension. The gravel and crushed rock was screened to pass through 1 in. circular holes and was also screened to exclude sand and pebbles less than ¼ in. in greatest dimension. The concrete was laid wet and worked with suitable bars to expel the air.



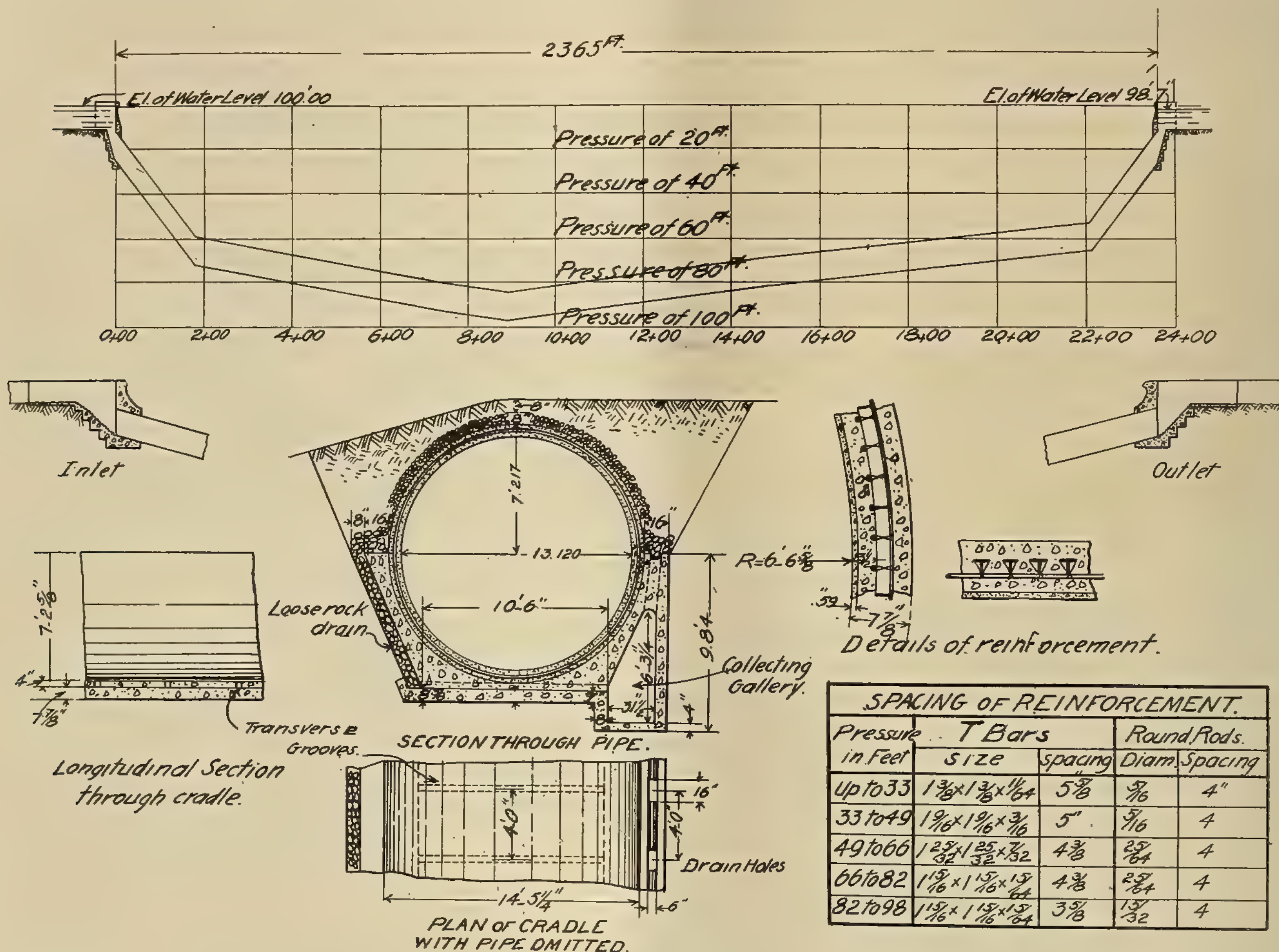
Details of M Line Siphon.

The trench was excavated carefully to the neat lines required and the final trimming was made not more than a few hours in advance of placing the concrete. Where necessary the trench is drained. The steel skeleton was built in the trench around the inside form. For one of the siphons, the Belle Fourche Siphon, Blaw collapsible steel forms were used. For the other two siphons special forms designed by the project engineer were used. These forms were made of lumber in several parts which could be bolted together and each part was small enough to pass though the erected form ahead of it. These forms have worked very satisfactorily. The work was done continuously and at a great deal less cost than the lowest bid the government could get from contractors.

The total cost for the Belle Fourche River siphon, 3565 ft. long, 5 ft. in diameter, under a maximum pressure of 65 ft., with an average head of nearly 50 ft., was $59,310. The reinforced concrete work cost $41,-929 or $18.92 a cu. yd., the remainder includes cost of excavation, trenching and backfilling, etc. Cement cost from $2.15 to $2.43 a barrel, f.o.b. Belle Fourche and had to be hauled sixteen miles. The haul of gravel was one mile. The steel cost was $.024 per pound f.o.b. Belle Fourche.

The reinforced concrete siphon of Albelda is located in the province of Huena, Spain, on the irrigation system of Aragon and Catalogne, seventeen miles down stream from another very important and interesting siphon, the Sosa siphon. Although this siphon of Albelda is a work of less magnitude than the Sosa siphon, it is technically much more important and interesting because of the greater pressure, larger diameter, and the absence of a steel tube to insure water tightness. The Sosa siphon is 3340 ft. long, consisting of twin pipes of reinforced concrete 12.47 ft. in diameter and subject to a maximum pressure head of 85 ft. The Albelda siphon is 2363 ft. long and consists of a single pipe of reinforced concrete 13.12 ft. in diameter and subject to a maximum pressure head of 97 ft. The most important difference between the two is in the design of the reinforcement. The twin pipes of the Sosa siphon consist of 158 sections 21.32 ft. long, joined by expansion joints. The reinforced concrete shell was made on a steel tube about ⅛ in. thick covered with a concrete layer 5.9 in. thick, reinforced with T bars, and an inside coat of reinforced mortar .87 in. thick. In the Albelda siphon there are no expansion joints and no steel tube to insure impermeability. The construction of this siphon was in charge of Mr. Mariano Luina, who was also engineer in charge of construction of the Sosa siphon. Mr. Luina has very kindly furnished the information given herewith.

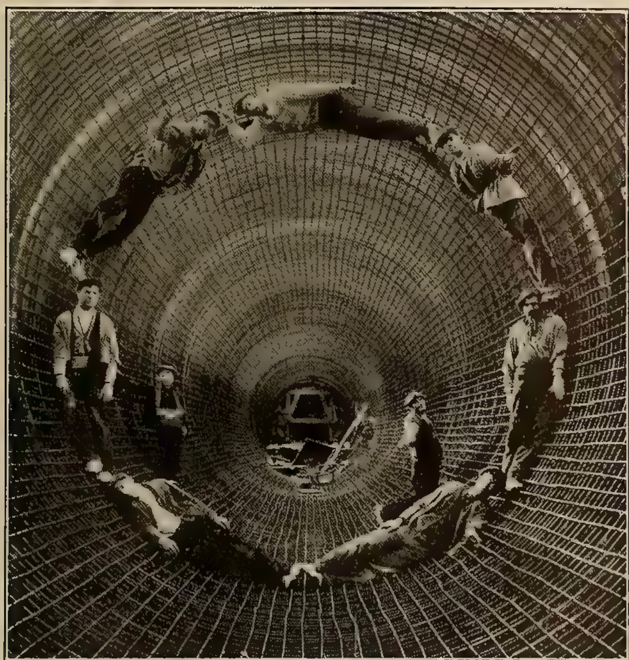
The conduit is 2380 ft. long between the inlet and outlet chambers and subject to a maximum pressure



SPACING OF REINFORCEMENT.				
Pressure in Feet	T Bars		Round Rods.	
	Size	Spacing	Diam.	Spacing
Up to 33	1⅜×1⅜×11/64	5⅞"	5/16	4"
33 to 49	1 9/16×1 9/16×3/16	5"	5/16	4
49 to 66	1 25/32×1 25/32×7/32	4⅜	25/64	4
66 to 82	1 15/16×1 15/16×15/64	4⅜	25/64	4
82 to 98	1 15/16×1 15/16×15/64	3⅝	13/32	4

Details of Albelda Siphon—Spain.

head of 97 ft. To empty the siphon a channel carries the water from the blow off at the lowest point in the siphon for a distance of 1000 ft. down stream, 410 ft. of this channel being covered. The conduit proper is a single reinforced concrete pipe 7.87 in. thick, supported up to its horizontal diameter on a concrete cradle. As it was expected that there would be more



Reinforcement in Place, Albelda Siphon—Spain.

or less leakage through the pipe, the cradle was given a peculiar shape designed to collect the seepage water and prevent it from softening and washing away the foundation.

This cradle is made of porous concrete and comprises a system of drains intended to collect and carry away all water percolating through the pipe and through the porous concrete of the cradle. On the right side of the cradle is the main collecting gallery. In the upper part of this gallery drain holes 3 ft. 3 in. deep, 16 in. long and 6 in. wide, spaced 4 ft. apart connect the gallery with a longitudinal semi-circular groove in the top of the cradle, in which the water percolating through the upper portion of the conduit collects. On the left side between the outer face of the cradle and the wall of the trench is a space of 10 in. filled with loose rock. The lower end of this loose rock drain rests on a concrete floor and is connected to the collecting gallery by a series of transversal grooves 4 in. wide and 3.14 in. high, running across the concrete floor and spaced 4 ft. apart. This concrete floor slopes towards the collecting gallery and has a thickness varying from about 7 in. at the collecting gallery to about 8⅝ in. at the foot of the loose rock drain. To keep the grooves opened when building the cradle, each groove was covered with a metal plate 5/16 in. thick. To drain the upper half of the conduit, it is covered with an 8 in. layer of broken rock. The concrete cradle was made of very porous material so that the water percolating through the lower half of the conduit would find an easy passage into the drains. The concrete used consisted of about 1 part of cement to 4¼ of sand and 8½ parts of gravel passed through a 2¾ in. screen. To examine the main collecting gallery tubular openings were provided each 197 ft.

The shell of the pipe is made up of 7.28 in. of concrete in which the reinforcement is imbedded and of an inside plaster lining of cement mortar .59 in. thick giving a total of 7.87 in. The reinforcement consists of 124 longitudinal round rods spaced about 4 in. apart, and of circumferential bars of T shapes and tied at their intersection to the longitudinal rods with wire about 1/16 in. in diameter. Each circumferential T bar has an exterior diameter of 13.4 ft. and is composed of two halves but-joined together with six rivets. The reinforcing steel has an ultimate strength of 37,000 pounds per sq. in. and its working strength was assumed at 14,200 pounds per sq. in. The concrete used for the conduit was a mixture of about 1 part of Portland cement to 1.28 parts of sand, 2.56 parts of gravel under 1¼ in., and .53 to 1.00 part of water, all by volume. The interior lining was made of equal parts of cement and coarse sand.

The interior forms were made in collapsible sections and in several parts so designed that a section could be taken apart and passed through the interior of the erected forms ahead. When completed the upper half of the conduit was surrounded with loose rock and covered with an earth fill. The concrete work was commenced on the 26th of November, 1908, and the main part of the siphon was completed on the 6th of March. The interior and all accessory works were completed on the 4th of April. The water was turned into the siphon and the conduit was tested on the 24th, 25th and 26th of May. The specifications required that the loss should be not greater than 1.32 gallons per second, diminishing to .79 gallons per second at the end of two months. The tests showed that the total seepage loss under the full head was only

Sosa Inverted Siphon—Spain.

.105 gallons per second, or about one-twelfth of the expected loss, and this diminished to 1/24 the following days and continued diminishing. The official inauguration was held on July 8th and was attended by the Minister of Public Works.

PIERSON, ROEDING & CO.

A Representative Western Electrical Establishment

1896-1913

H. R. Noack, President. Thos. Finigan, Vice-President.

G. R. Murphy, Treasurer.

G. P. Dahle, Secretary.

San Francisco Office.
Rialto Building

Pierson, Roeding & Co., the well-known manufacturers' representative, has in the past two years expanded rapidly to meet the growing business of the electrical field on the Pacific Coast. This company has a somewhat unique position in that it specializes entirely on materials entering into the construction and maintenance of electric railways, power transmission lines, underground conduit systems, hydraulic equipment, and storage batteries. It is active in this field in all of the states west of the Rocky Mountains, as well as in British Columbia and the Hawaiian Islands.

The present extensive organization is the development of an agency business founded sixteen years ago by Mr. Jno. Martin and operated for a number of years by Jno. Martin & Co., handling electrical lines exclusively, and by the Martin Pipe and Foundry Company, who dealt extensively in cast iron water, gas

Interior San Francisco Office.

Portion of Sales Office.

Private Offices.

Private Office.

and soil pipe. Since the inception of the business, it has been the policy of the founder, as well as the management of Pierson, Roeding & Co., to confine their efforts to the development of high-grade specialties only. The prominent part which Jno. Martin & Co. and Pierson, Roeding & Co. have taken in the pioneer work in the electric power transmission and electric railway fields on the Pacific Coast is too well known to require special mention.

The growth of the business has necessitated the establishment of various branches on the Pacific Coast, and in addition to commodious headquarters on the ground floor of the Rialto Building, 118-130 New Montgomery street, San Francisco, the company now maintains branch offices in Seattle, Colman Building; Portland, Spalding Building, and Los Angeles, Pacific Electric Building.

S. K. Colby

Owing to the recent resignation of Mr. S. K. Colby, Vice-President, there has been a reorganization in their personnel. While Mr. Colby will no longer be identified with the Pacific Coast organization, he will retain his interest and remain a director as heretofore.

Mr. H. R. Noack retains the position of President of the company. After leaving the University of California in 1898, Mr. Noack accepted a position with Mr. Martin and since that time has been identified without interruption in the development of the present large business of the company.


Auditing Department.

The position of Vice-President has been accepted by Mr. Thomas Finigan, until recently Purchasing Agent of the United Railroads of San Francisco. During his association with the United Railroads, Mr. Finigan has made a host of friends, whose well wishes have followed him into his new position.

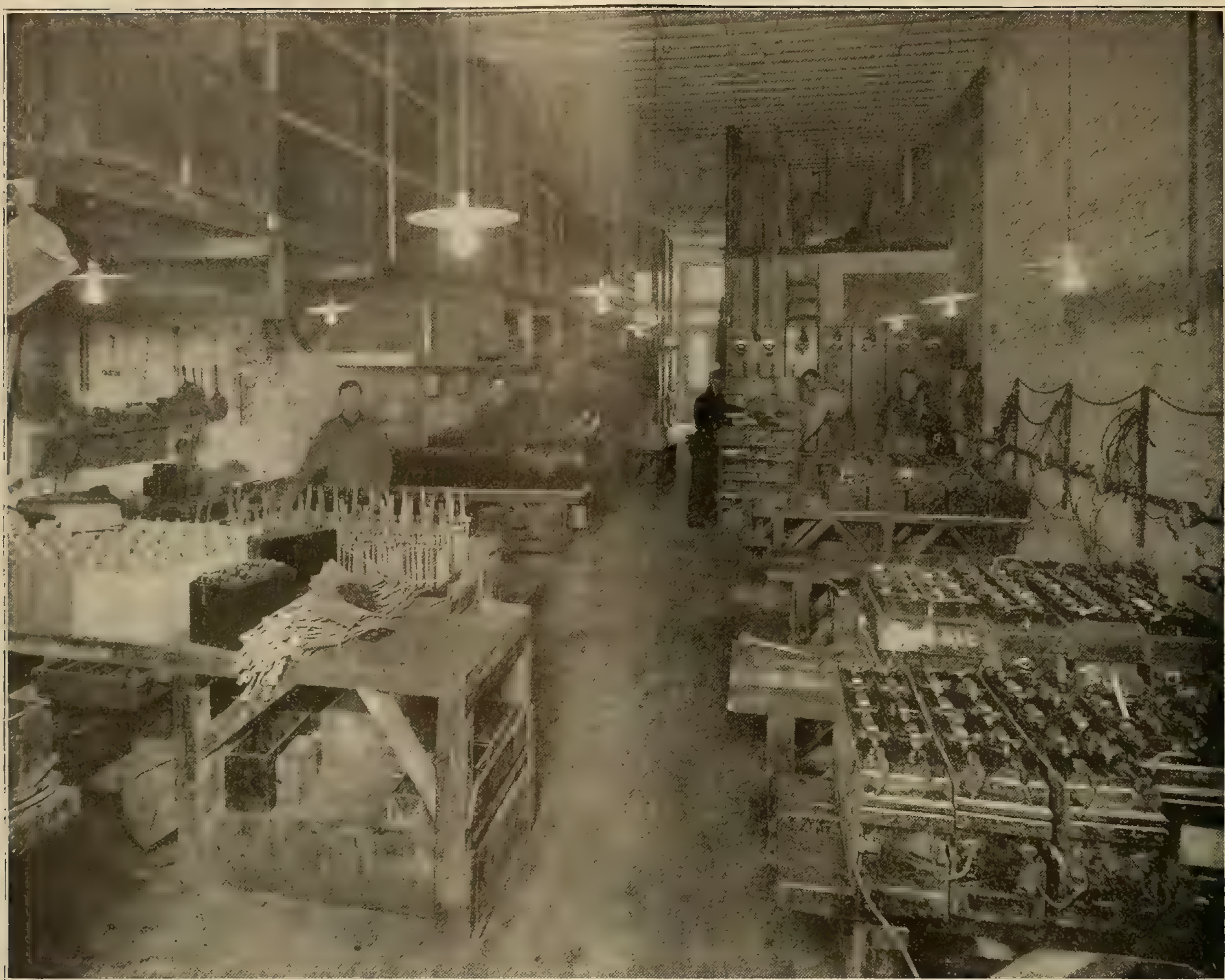
The Treasurer of the company is Mr. George R. Murphy, who is also in charge of the Storage Battery Department. Mr. Murphy was graduated from Columbia University and then became associated with the Metropolitan Street Railway of New York on power station work. In 1900 he entered the employ of the Electric Storage Battery Company as engineer of the operating department in the New York office. In 1903 he was placed in charge of the operating and construction departments on the Pacific Coast, which position he held until his association with this company in 1909.

The Financial Department of the company is in charge of the Secretary, Mr. Geo. P. Dahle, who has been actively associated with the company and its predecessors for the past twelve years.


A. L. Havens

The Los Angeles branch of the company is in charge of Mr. A. L. Havens, who has been identified with electrical interests since his graduation from Dennison University in 1895. After leaving the university, Mr. Havens was associated with the Western Electric Company, Chicago, and later with the Kilbourne & Clark Company of Seattle, and then with the Ohio Brass Company in


Display Room.



Exide Battery Department.

their Chicago office, which position he left to assume his present duties in Los Angeles.

S. H. Lanyon

The Portland office is in charge of Mr. S. Herbert Lanyon, who has made an enviable reputation as a designing and construction engineer in connection with large industrial plants.

N. H. Silver

Mr. N. H. Silver, the manager of the company's Seattle office, was for a number of years associated with the Fort Wayne Electric Works, and later took charge of the manufacturing department of Agutter-Griswold Company at Seattle, which position he resigned to take up his present work.

Much of the success of the company has been attributed to the special service rendered in the work in which it is engaged, and made possible by the careful segregation of its lines into departments. Each department has been placed in immediate charge of a specialist in his line. The President of the company, Mr. H. R. Noack, is in charge of the Transmission Department, while the Railway Department is managed by the Vice-President, Mr. Thomas Finigan.

F. A. Richards

The Car and Truck Department is under the management of Mr. Ford A. Richards, who requires no introduction to the railway companies on the Pacific Coast nor in the Middle West. Mr. Richards was associated for a number of years with the Peckham Manufacturing Company and later joined the forces of The J. A. Hanna Company and made a specialty of the sale of electric cars and trucks. He resigned this position to accept the management of the Car and Truck Department of this company, representing The J. G. Brill Company and subsidiaries on the Pacific Coast.

C. G. Gauntlett

An Underground Conduit Department is maintained, at the head of which is Mr. C. G. Gauntlett, whose experience covers this class of work both abroad and in the United States. Mr. Gauntlett was for a number of years associated with Siemens Bros. & Co, Ltd., at their London office. He was later connected with the Pacific Gas & Electric Company at San Francisco as Construction Engineer in the Underground Conduit Department, until he assumed his present duties.

F. L. McGillan

An important part of the company's business is in the sale of poles and cross-arms. The management of this department is in charge of Mr. F. L. McGillan, whose training in the pole business was obtained with the Valentine Clark Company of Chicago, when he was in charge of their numerous pole yards as General Superintendent. In 1907 he was tendered and accepted the office of Vice-President and General Manager of the California Pole and Piling Company, with headquarters at San Francisco, which office he resigned to take charge of his present department.

E. G. Dewald

The Hydraulic Department is in charge of Mr. E. G. Dewald, whose identification with the designing and engineering of many of our most prominent hydroelectric plants has established his reputation as second to none in this line of work.

J. G. Reed

The Purchasing and Shipping Departments are under the supervision and control of Mr. James G. Reed, whose long association with the Southern Pacific Company gave him a broad experience in transportation details.

An important adjunct of the company's Pacific Coast business is the maintenance of an Exide Battery Depot for the manufacture and repair of electric storage batteries. A corps of storage battery engineers is also maintained for the construction and inspection of power and vehicle batteries. The Exide Depot Department occupies a separate building on Howard street, from which point the company's entire Pacific Coast business is served.

Exide Battery Depot.

A warehouse is maintained at San Francisco, at which an endeavor is made to carry a sufficient stock of transmission line materials, underground conduit and railway supplies to take care of the requirements of all of the company's sales offices.

PROTECTING CROPS BY TELEPHONE.

A novel application of the rural telephone to one phase of farming conditions has been made by a Wood River Orchard Company operating fruit orchards near, Weiser, Idaho. It is a well known fact that one night of frost may spoil an entire season's crop. The Wood River Company having this in mind decided to take measures whereby they could get ample warning of the approach of frost and make preparations in time to ward off its bad effects on the apple crop.

Thermometers of the dial type are placed in each of the four corners of the valleys. On each dial face there is a platinum contact which can be moved to any point on the dial, while another contact point is located on the indicator needle. For orchard use the dial contact point is placed at about 45 degrees Fahrenheit. When the temperature drops to this point, the two contact points come together and close a local circuit. In this local circuit there is an interrupter or pole changer arranged to send an alternating current over wires which connect with a sectional unit type switchboard at the main office of the company. This alternating current operates a signal on the switchboard and indicates to the operator that frost is near at hand. As the thermometers are placed at the four cardinal points of the compass it become a simple matter to determine from what direction the frost is coming. The switchboard operator having received the signal, calls each of the orchard men who would be effected by the frost.

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POWER AND GAS

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Changes of advertising copv should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advrtisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
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CONTENTS

Tact

An easement is a curve used in engineering design to avoid any sudden change in the direction or acceleration of moving masses. It is the process that gives gradual guidance to minimize the shock resulting from change in mass motion. Such is the transition curve in a railway track, which lessens the force of impact in passing from a tangent to a turn. The dash-pot of a steam engine is likewise intended to eliminate vibration in the machine parts. Hydraulic pipe lines are constructed with easement curves to connect straight runs to circular arcs. The guiding vanes in pumps and turbines are but easement curves. Even the flexibility of electric transmission would theoretically require the absence of sharp turns, as otherwise there is an apperciable loss of power in sudden bends.

The theory of easements seems to be but a part of the great law of Nature that recognizes the inefficiency, if not the impossibility, of a cataclysm. We see this law exemplified in the long continued detrital accumulation that builds the sand bars, and in the accumulative accretion that develops animal and plant life. Even the cataclysm is due to slow and gradual, but incessant, changes that ultimately seek violent vent, unless easement is provided.

A great invention, that appears to come with the suddenness and the brilliancy of an unpredicted comet, has been a long time materializing in the minds, not only of the inventors, but of many others before, who have provided the curves of easement.

In business, as in mechanics and Nature, there are certain easements that make smooth its course. The home and school training of a lad are but the easement curves that prepare him for the buffetings of business. The polish possessed by one from whom the crudities and rough edges of individual personality have been worn is an easement curve to success. Tact and diplomacy in the central station man are the easements that smoothly guide a business through industrial turmoil. A business conducted in obedience to these principles, like a ship of good "lines," will make better progress and avoid the shocks which come from abrupt changes.

Tact originally meant the sense of physical touch, but gradually it has become restricted in meaning to the exercise of the sense of touch with reference to human character; that rare combination of courtesy and justice which constitute skill in dealing with men. To define it is as difficult as to impart it. It may be observed in every successful employee of a public service corporation, for tact is as necessary as is a knowledge of the business.

Frictionless contact with consumers is as impossible as frictionless bearings in machinery. A judicious application of tact will minimize the effects of such friction, lubricating any irritating conflict of opinion and making smooth the course of business. When used too copiously, however, in the form of "jolly" its insincerity becomes manifest and its beneficial results nullified.

A piece of grit sometimes gets into the best regulated machinery, and all the oil in the can is not as effective as a general cleaning that removes the complaint. Prompt action on legitimate complaints prevents much damage. These should not be confounded with the imaginary troubles of the chronic complainer which, like the squeak in the engine that came only with the presence of the ventriloquist, causes unneccessary trouble. The public has become educated to expect good service, whether of gas, electricity, water, telephone or transportation facilities. The first requisite in meeting this expectation is tact.

Hydraulic Power

A clear understanding of the fundamental principles underlying the action of hydraulic machinery is essential to every engineer. These principles are so simple and so easily comprehended that they form the basis of many analogies in the explanation of more involved phenomena. Hydraulics deals with water in motion. The power developed by moving water depends upon its weight and velocity, which is found from the volume and the distance through which it has moved. Hydraulic machinery may be classed under two general heads: machines which move water, and machines which are moved by water. The second class includes not only water wheels and turbines, in which the action of the water is largely due to kinetic energy, but also those devices in which the static pressure of water is employed to do useful work.

Nature's greatest force is that exerted by solar energy. Whether available in plants as food, in the earth as fuel, or in the air as potential electricity or hydraulic head, the heat from the sun is the source of man's every power. It is not surprising, therefore, that the ancients worshiped the sun as a god. It supplies the heat to vaporize the water and then raise it to great heights as clouds. They act as storage reservoirs until condensation takes place on the mountain sides. Like many other forms of energy, its utilization is inefficient. Means of harnessing the energy liberated by the condensation of water in the atmosphere are yet to be devised. Its strength is occasionally made manifest in the lightning; its beauty in the aurora; but the wisdom of man has yet been unable to control the great potentialities continually being dissipated without accomplishing anything. Opposing the sun's force in many respects is the force of gravity. The sun's power is positive. That of gravity is negative. For gravity pulls down what the sun's rays have raised. While these two forces are universal, yet they do not become available for the production of water power without the instrumentality of topographic relief. By its means the feeble efforts of tiny streamlets are concentrated into the great power of mighty rivers. It also gives to water the head by virtue of which power is developed. A small quantity of water under a great head is just as powerful as a great quantity under a small head.

For countless ages the tremendous energies of the world's water power ran riot. They did nothing except wear away the surface of the earth and dash themselves in futile spray. The kinetic energy of the waterfall was an unknown possibility until man tried to restrain it. Then it was found that hydraulic power could be obtained by interrupting the great cycle through which water is continuously moving. This motion is as near to being perpetual as any that man can use. "It is as old as the hills," as eternal as the sun, and as ceaseless as the law of gravitation.

Defense of Mathematics

A toast recently given at a banquet "Here's to mathematics! May it never be of any use to anybody," indicates an unfortunate feeling of antipathy for figures that exists in the minds of many practical men. Most of them are unconsciously making daily use of methods and machines whose first principles were deduced by mathematicians. The micrometer with which they measure their work and the glasses they may wear are alike dependent upon the mathematician for their correctness. This antipathy is much akin to the scorn for theory in general and is one exception to the old adage "familiarity breeds contempt." The sentiment is turned to one of respect when we consider how soon this world of ours would go awry if astronomers could not give us the time, if bankers could not account for our money and if engineers built bridges by guess work.

The relation between the mathematician and the mechanic is much like that between the explorer who discovers a country and the settler who develops it. A mathematical calculation, once made, blazes the trail of those who come after.

Like any tool it gives the best results when skillfully used. A mistake in numerical substitution in a trigonometric formula may be as disastrous as putting the decimal point in the wrong place. It requires judgment to decide how far to carry the refinements of a calculation which involves several approximations. It is usually an accident if actual results coincide with those predicted by figures. An indicator card on a steam engine is seldom the duplicate of the one plotted from a formula, but the latter can be easily made before going to the expense of manufacturing what may prove to be a poor machine.

An interesting example of how two methods may give much the same result is afforded by European and American designs of water wheels. The early American wheels, particulaly those of the impulse type, were an experimental attempt to produce a machine that would get the most power from the water and that would wear the longest. German and Swiss engineers designed their wheels in accordance with the mathematical laws of hydraulic flow in turbines, the purpose being to minimize the velocity of exit and to reduce to the lowest possible value the shock of the entering water. In practice the American type has proved as efficient as the European, the design being nearly identical in some cases, one thus confirming the other.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Donald E. Campbell of the Vote-Beger Company, La Crosse, Wisconsin, is in Seattle.

J. B. Price of the Sturdevant Vacuum Company, Boston, spent a week in Seattle recently.

H. R. Noack, president of Pierson, Roeding & Company, San Francisco, has left for a trip through the East.

C. E. White of the Holophane Company, General Electric Company, Cleveland, Ohio, was in Seattle last week.

W. G. Carey, manager of the General Electric railway supply department, Schenectady, was in Seattle some days ago on a business trip.

H. T. Robescheit of the Westinghouse Lamp Company, previously in the Spokane office, has been transferred to the San Francisco office.

C. V. Aspinwall, city salesman of the Westinghouse Electric & Manufacturing Company, Seattle, attended the Rose Carnival in Portland.

G. A. Richardson, superintendent of railway, Puget Sound Traction, Light & Power Company, Seattle, is in Boston and will visit Chicago before his return.

R. J. Bird, sales manager of the Western Wood Preserving Company, of Los Angeles, has completed a tour of the south coast and San Joaquin territory.

Morton Ramsdell, sales manager of the Puget Sound Traction, Light & Power Company, who has been in the East for about six weeks has returned to Seattle.

R. H. Griffin, manager of the Western Electric Company's pole department, New York, is touring the Pacific Coast and is expected to arrive in San Francisco this week.

W. C. Taylor of the General Electric Company at Schenectady, who has been doing work in California oil fields for the past few months, left for the East this week.

O. N. Wiswell, superintendent of the Puget Sound Traction, Light & Power Company plant at Snoqualmie, Washington, has returned from a two weeks' vacation in Spokane.

Frederick S. Pratt, vice-president of the Stone & Webster Management Association, has arrived in Seattle from Boston and will be in the Puget Sound district for about a month.

F. H. Leggett, manager of the Western Electric Company, has just returned from a trip through the Pacific Northwest and reports bright prospects along business lines in that section.

Wm. E. Roos of the Western Wood Preserving Company, of Los Angeles, will shortly establish his headquarters in San Francisco, where he will devote his time to the interests of the company.

Prof. Philip S. Biegler of the school of engineering of the University of Montana, Missoula, Mont., will spend the summer in the engineering offices of the Washington Water Power Company, Spokane, Wash.

C. Heise, manager of Westinghouse Electric & Manufacturing Company, San Francisco, returned the first part of the week from Chicago, where he has been in attendance at the National Electric Light Association Convention.

W. J. Grambs, superintendent of light and power, and **G. E. Quinan** operating superintendent of the Puget Sound Traction, Light & Power Company, Seattle, have returned from the National District Heat Association conventian held in Indianapolis and the annual convention of the National Electric Light Association held in Chicago.

MEETING NOTICES.

Electrical Development and Jovian League—San Francisco.

Officers and committees in full for the term ending December 31, 1913, were announced as follows: President, W. S. Berry; Vice-president, W. F. Neiman; Sec.-Tres. E. B. Strong; Executive Committee—W. L. Goodwin, F. Watts, H. R. Noack, F. J. Cram; Entertainment—A. Rowe, R. L. Waldon, Ed. Whaley; Membership—W. R. Dunbar, A. E. Drendell, J. G. DeRemer; Ways and Means—C. C. Hillis, C. F. Butte, T. E. Bibbins; Finance—C. E. Wiggin, W. W. Hanscom, S. J. Lisberger; Grievance—Louis Levy, S. P. Russell, R. J. Holtermann; Good Fellowship—G. I. Kinney, S. J. Walton, A. H. Halloran; Publicity—A. H. Halloran, J. W. Redpath, G. L. Bayley; Legislative—H. V. Carter, Garnett Young, C. Heise; Retail Trades—L. Levy, W. D. Kohlway.

On vote it was decided the League should take a two months' vacation from July 1 to September 1, 1913, on account of many of the members being away during the summer season.

The meeting was then turned over to the Contractors, it being their day to take charge of the entertainment. Unthe guidance of W. S. Hanbridge, secretary of the Electrical Contractors' Association, a very delightful hour was passed. Mr. C. F. Butte told of the electrical installation at the new city and county hospital, illustrating his talk with stereopticon pictures. M. F. Delew also gave a few remarks on indirect lighting. Added to the foregoing was a drawing contest in which G. F. Belden won an electric iron; W. S. Coleman, a toaster; A. E. Drendell, electric pocket lamp; H. V. Carter, cigar lighter, and W. S. Taylor, an electric comb.

Oregon Society of Engineers.

A special meeting of the Oregon Society of Engineers was called Monday evening, June 9th, 1913, at their club rooms, 247½ Stark street, for the purpose of endorsing an engineer as a candidate for City Engineer of Portland, to serve under the new commission form of government. After a lengthy discussion the matter was referred to the Executive Board of the society.

Semi-Annual Convention Oregon Electrical Contractors' Association, Portland, Oregon.

At 8:00 P. M. Monday evening, June 9, 1913, the Oregon Electrical Contractors' Association met in the Portland Railway Company's hall at First and Alder streets. Mr. J. L. Bradfield, northwest representative of the National X-Ray Reflector Company, gave an illustrated lecture on "Indirect Lighting." His talk covered the history and development of the indirect system of lighting. He also showed several modern installations and gave data in regard to same. Mr. F. H. Murphy, illuminating engineer of the Portland Railway, Light & Power Company, and Mr. J. C. English of the J. C. English Fixture Company discussed Mr. Bradfield's lecture.

Portland Electric Club.

F. D. Hunt, traffic manager of the Portland Railway, Light & Power Company, was elected president of the Portland Electric Club at its annual meeting held on Wednesday night. The Electric Club was organized four years ago and is made up of employees of the street railway and electric light company. B. S. Josselyn, the retiring president of the Portland Railway, Light & Power Company, gave an informal address. The officers chosen for the ensuing year were as follows: Vice-president, J. R. Wood; secretary, W. T. Buchanan; trustees, A. P. Campbell, Fred Cooper and G. J. Kelly. The meeting was well attended.

Oregon Technical Club.

The regular Monday meeting of the Oregon Technical Club was devoted to a reception of the visiting architects who were in attendance at the Third Annual Convention of the Architectural League of the Pacific Coast. Mr. Edgar M. Lazarus, president Oregon Chapter A. I. A., gave a short address of welcome to the guests of the club. Mr. D. O. Lively, head of the Live Stock Department of the Panama-Pacific International Exposition, briefly outlined the ideals of the exposition and the work so far accomplished. Mr. Whittier, of Washington, D. C., editor of the Journal of American Institute of Architects, spoke on the ease with which Portland could avoid the serious and expensive mistakes of older eastern cities, by now adopting some definite plan for handling the traffic of the future. Other speakers were Mr. Frank Logan, president of the Portland Architectural Club, and Mr. C. M. Lewis, editor of the Pacific Builder and Engineer of Seattle. About 100 members and guests were present. Mr. W. H. Graves was chairman of the day.

Electrical League of Southern California.

At the regular meeting of the League held in the Angelus Hotel, June 17th, Mr. O. O. Reynolds, president of the Board of Public Utilities, gave a talk on "Some Unsolved Public Utility Problems." The last meeting of the League until September will be held on June 24th. Mr. Paul Shoup, president Pacific Electric Railway, will speak on "Transportation."

Seattle Electric Club.

The Electric Club of the Puget Sound Traction, Light & Power Company, Seattle, held its annual meeting at the Rathskeller on the evening of June 10. Dinner was served and officers elected for the ensuing year. F. M. Hamilton was electetd president, L. A. Wallon, vice-president, and D. P. Pierce, secretary-treasurer. Members to the number of 135 were present. Meetings are held every two weeks during the winter months. The purposes of the club are social and educational.

Washington Stone & Webster Club.

The Stone & Webster Club of Washington held its annual meeting on the 29th day of May. W. J. Grambs of Seattle was elected president and Donald C. Barnes of Everett, Louis Bean of Tacoma, Leslie R. Coffin of Bellingham and A. L. Kempster of Seattle were elected vice-presidents. E. A. Batwell was re-elected secretary and F. O. Straight treasurer. The trustees are: John Hickok Jr. of Bellingham, W. E. Best of Seattle, B. T. Longmo of Tacoma and George Newell of Everett.

Cooperstown Convention of A. I. E. E.

Following is the program of the Thirtieth Annual Convention of the American Institute of Electrical Engineers to be held in Cooperstown, N. Y., June 23-27, 1913:

Monday—Reception and Dance, Hotel O-te-sa-ga, 9:00 p. m.

Tuesday—President's address, 10:00 a. m. Introduction of President-elect C. O. Mailloux. Telegraphy and Telephony Committee; Electrochemical Committee; Educational Committee, 8:00 p. m.

Wednesday—High-Tension Transmission Committee, 10:00 a. m. Industrial Power Committee, 2:00 p. m. Board of Directors' meeting, 8:00 p. m.

Thursday—Power Station Committee, 10:00 a. m. Electric Lighting Committee. Meeting of Executive Committee on Organization of International Electrical Congress, San Francisco, 1915. Afternoon, Presentation of Edison Medal, 8:00 p. m. Conference of Officers and Section of Institute Affairs, 8:30 p. m.

Friday—Electrophysics Committee, 10:00 a. m.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Upon request of applicant, a decision was rendered dismissing the application of the Southern Sierras Power Company for a certificate of public convenience and necessity to serve the city of Redlands.

The city of Burbank has applied for authority to purchase property of the Miradero Water Company for $20,000.

The city of Fullerton has applied for authority to purchase the water system of the Fullerton Domestic Water Company for $80,000.

A supplemental order has been issued granting authority to the Southern Counties Gas Company to issue $4000 of bonds.

A supplemental order has been issued granting authority to the Tulare County Power Company to pledge $23,000 of bonds as collateral security for a loan of $17,212.57.

The Oakland, Antioch and Eastern Railway has applied to the Railroad Commission for authority to issue $1,000,000 of 5 per cent bonds. The money is to be used in the completion of the road from Bay Point to Sacramento.

The Central California Gas Company has applied for authority to issue $10,000 of money heretofore authorized for a gas holder, for other apparatus and machinery for its gas plant at Visalia.

The Home Telephone and Telegraph Company of Chino has applied for a certificate of public convenience and necessity to construct and operate a telephone and telegraph system in the city of South Pasadena.

The Oro Electric Corporation and the Oro Development Company have filed an application with the Railroad Commission for authority to issue $1,000,000 of bonds. The Commission is asked also to confirm the sale by the corporation of $686,000 of its bonds.

NEWS OF OREGON STATE RAILROAD COMMISSION.

The commission has announced that it would hear evidence July 9th in the Multnomah court house in the case of Wright & Dickinson, proprietors of the Oregon Hotel, against the Pacific Telephone & Telegraph Company, and the Home Telephone Company. An interchange system in the hotel to obviate having two telephones in each room is the question at issue.

The commission has issued an order that the Portland Railway, Light & Power Company on its Estacada branch hereafter shall check the baggage of passengers the same as other railroads.

The commission won before the United States Supreme Court in the Milwaukee and Oak Grove fare. The order of the Commission, reducing the fare between Portland and Milwaukee from 10 to 5 cents and between Portland and Oak Grove from 15 to 10 cents, has been approved by the United States Supreme Court, as has the order requiring the Portland Railway, Light & Power Company to grant to citizens of these two suburbs the same transfer privileges in Portland as are granted to residents of Mount Scott. The former matter has been unsettled for five years.

CONVENTION SOUVENIRS.

Cutler-Hammer Control in Chicago is the title of a little booklet issued by the Cutler-Hammer Manufacturing Company, for delegates to the 1913 N. E. L. A. convention. Beginning with the Medinah Temple, which was the center of the convention, this booklet describes office building, public buildings, educational institutions, hotels, clubs, theatres, department stores, mail order houses, newspapers, commercial pri[illegible] street railways, central stations, the drainage canal and steel mills, and comments on the electrical equipment used in connection with these enterprises. A map of the Chicago business district is inserted at the close of these interesting de-

scriptions. A unique "Handy Guide," made for the pocket, and containing pictorial directions for reaching places of interest, completes the Cutler-Hammer Manufacturing Company's contribution toward making the convention visitor feel at home.

LOS ANGELEC GAS & ELECTRIC CORPORATION PICNIC.

The Los Angeles Gas and Electric Corporation entertained its employees and their families at a picnic Saturday, June 7, when nearly 4,000 persons were the guests of the corporation. Three special trains conveyed the guests from Los Angeles to Baldwin's Ranch and every guest had a seat.

The mechanical department won the morning baseball game from the office department by a score of 12 to 5, securing a silver cup donated a year ago by Mr. Walter B. Cline, president of the corporation. The cup was won last year by the office force. Another big athletic event was the tug-of-war for a silver trophy cup donated this year by President Cline. This was won by a team from the gas works, contesting with teams from the gas shop, the electric shop, and a combination team made up of employees of the electrical, transportation, and store departments. J. H. Powell of the office force won the high and broad jumps; A. B. Mauch of the gas works won the 100-yard and 220-yard dashes and the shot put; E. A. Boulger of the electric shop won the half-mile run; a team from the electric shop won the relay race.

The children's playground was one of the big features of the picnic. A section of the grounds had been set apart where swings and teeters had been erected and a dozen burros were kept busy riding the children around the grounds.

The manner and time in which the immense crowd was fed reflects credit to the corporation. Every guest had been provided with a ticket that entitled him to a box of lunch. At noon the guests moved in single file past long lunch counters where a large corps of busy waiters exchanged boxes of lunch for the tickets. The boxes were well filled with an especially appetizing lunch. At other lunch counters hot coffee was served, and at still others cornucopias of ice cream. Barrels of ice water, lemonade and punch were placed all over the ground and kept filled all day. The picnic has been an annual feature for four years. Everything is furnished free by the corporation.

TRADE NOTES.

The Dedrick Electric Supply Company is withdrawing from the electrical supply business in Portland.

The University of Washington has just placed an order for 9000 feet of Johns-Manville ⅜-in. wall fibre conduit.

Kilbourne & Clark Manufacturing Company of Seattle is shipping a 100 kw. power plant to its Australian branch house.

The Portland Electrical Works have obtained the contract for the Blazier Building at Third and Burnside streets, Portland, Oregon.

The Fobes Supply Company, Seattle, has supplied a 500 volt direct current, weather-proof, 14-in. bell for the Eleventh street bridge at Tacoma.

The Pacific States Electric Company, Seattle, has been successful in having Union metal lamp standards installed by the city of Cashmere, Wash.

The 800 ton concrete building of the Portland Railway, Light & Power Company at Vancouver, Wash., has been moved to the foot of Main street.

W. R. Hendrey & Co., Seattle, have secured the contract for the motor equipment in the King County rock-crushing plant at North Bend at approximately $2300.

The Morrison Electric Company, Portland, Oregon, has obtained the electrical contract for the new building on the southwest corner of Third and Flanders streets.

The annual picnic of the employes and officials of the Puget Sound Traction, Light & Power Company will be held on the 25th day of June at Fortuna park on Mercer Island, Lake Washington.

The North Coast Electric Company, Ltd., newly incorporated, has absorbed the interests of B. C. Holst & Company and will conduct an electrical jobbing house, at 409-411 Cordova street, West, Vancouver, B. C.

H. G. Behneman, manufacturers' agent, Seattle, has delivered two car loads of street railway poles, manufactured by the Electric Railway Equipment Company of Cincinnati, for the Seattle municipal street railway.

The Bowie Switch Company of San Francisco reports an order this week from the Southern Sierras Power Company, being a further equipment of their recent line extensions of Bowie circuit-breakers for their 150,000-volt circuits.

The American District Steam Company, Seattle, is making shipments of material for the installation of a steam heating plant to serve the business section of Olympia, Washington. It is to be in combination with the proposed electric plant.

The Pacific Lamp and Supply Company, Seattle, agents for the Packard Lamp Works of Warren, Ohio, has been awarded the contract for supplying incandescent lamps to the city of Seattle for the coming year at a cost of approximately $91,000.

City Electricians Dunlap of Portland and Howard Joslin of Seattle have approved the ebony asbestos wood manufactured by the H. W. Johns-Manville Company of Seattle for switchboards and switch bases, on account of mechanical strength and insulating qualities.

Nelson Bennett, Tacoma contractor, has about completed the extensive tunnel on the Northern Pacific line between Tacoma and Portland, near Point Defiance Park. The tunnel will be nearly two miles in length. General Electric mine locomotives and other electrical equipment were used in the work.

The Seacoast Mining Company, Valdez, Alaska, will install a 150 kw. hydroelectric plant consisting of a 290 h.p. turbine equipped with synchronous motors, by-pass and pressure regulator, together with governor, transformer and switchboard apparatus. The complete equipment was furnished by the Allis-Chalmers Company.

The Pacific States Electric Company, Seattle branch, has been appointed agency for the Phillips Insulated Wire Company's O. K. and Parac Wires. The company in the past handled the products of the Phillips Insulated Wire Company at all of their other houses, but the Seattle appointment has just become effective. Stocks of both articles are now available.

Henry C. Moss, illuminating engineer, Seattle, has just completed plans and specifications for the lighting equipment of the 15-story office building of the Dominion Stock & Bond Corporation at Vancouver, B. C. He also is designing the electrical equipment for an 8-story office building to be erected in the same city for Credit Foncier, and for a large steam laundry for the Sanitary Laundry & Linen Supply Company.

The Hallidie Machinery Company, Seattle, is supplying the city of Seattle with 3 Ridgway Dynamo and Engine Company 500 kw. motor generator sets. Each set consists of a 2-phase, 60-cycle, 7500-volt, alternating-current, synchronous motor and 300-600-volt, 500-kw., 3-wire, direct-current generator, with direct-conected starting induction motor and exciter, complete with basin bearings. The equipment is to be used in connection with the city lighting plant.

The Sitka Wharf & Power Company of Sitka, Alaska, has placed an order with S. Morgan Smith Company, York, Pa., through its Seattle agents, Bates & Clark, for a 325 h.p. water wheel, effective head 60 ft. The plant will be erected on Sawmill Creek at a point about 4½ miles from Sitka and power will be furnished from a 3-phase 6600 volt transmission line consisting of No. 6 hard-drawn copper wire. A wood stave pipe line 42 in. in diameter and 1300 ft. long will be built. The 600 r.p.m. Westinghouse generator will have a maximum continuous capacity of 270 kw. at 90 per cent power factor.

The Westinghouse Electric and Manufacturing Company has recently received the following orders:

Oakland, Antioch and Eastern Railway Company, San Francisco, Cal., one 750-kw. synchronous motor generator set consisting of one 11,000-volt, 3-phase, 60-cycle motor and one 1100 volt d.c. generator. The Pacific Gas and Electric Company, San Francisco, Cal., three 1000-kw. synchronous motor generator sets consisting of 11,000 volts, 3-phase, 60-cycle motors and 600-volt d.c. generators. Portland Railway, Light and Power Company, Portland, Ore., one 500-kw. synchronous motor generator set consisting of one 3-phase, 60-cycle, 720-r.p.m. motor and 600-volt d.c. generator with direct-connected exciter and starting apparatus.

NEW CATALOGUES.

The Holophane Works of the General Electric Company has issued Bulletin No. 28 devoted to Holophane Decorative Shades.

Under date of April, 1913, the National Board of Fire Underwriters has just issued a list of approved electrical fittings. Copies of this book may be obtained from the San Francisco office.

The New York Insulated Wire Company has issued booklet No. 23 which gives prices on rubber covered wire for different copper bases from 12 to 20 cents. Freight additions for Western points are also given.

The Westinghouse Electric & Manufacturing Company has issued descriptive leaflet No. 3679 covering Electric Vehicle Battery-Charging, Switchboards and Motor Generator Sets, and folder 4255, devoted to Westinghouse Type PG Porcelain Insulators.

The General Electrical Company has recently issued the following bulletins: No. A4122 devoted to Cornice Bus Arc Panels and Brush Arc Generators; No. A-4141 describing Central Station Oil Switches for use on systems of voltages up to 110,000; No. A-4109 describing Belt-Driven Revolving Amature Alternators; and No. A-4035 devoted to Series Luminous Arc Lamps.

The Westinghouse Electric and Manufacturing Company has recently issued the following bulletins: No. 3666, covering semi-automatic elevator controllers designed for slip-ring a. c. motors; No. 3664 describes the application of electric drive to mining and milling machinery; No. 3657 is devoted to motors for crushing and concentrating mills; "Motors for Mine Hoists" is the subject of No. 3655, which contains much matter of interest and value.

In a new 24-page Bulletin (No. 8502) The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., describe the latest type of Simplicity theater dimmer for two-wire and three-wire circuits. These dimmers are made especially for use with tungsten lamps and where an extremely fine regulation of the lamp brilliancy is desired. The Bulletin contains very complete description and has many illustrations. Bulletin 8515 describing Spot Light Dimmers is also being distributed.

The Engineering Department of the National Electric Lamp Association has just distributed a bulletin entitled "Mazda Street Railway Lamps." The bulletin gives the latest information concerning the lighting of street railway cars by means of high efficiency Mazda lamps. It contains illustrations of the lamp used in this class of illumination as well as of a car in which the latest car lighting scheme is applied. Considerable technical data on the lamps and their performance is given, including cost tables and performance curves.

RATE RESEARCH.

Within the year a new publication, Rate Research, published by the Rate Research Committee of the National Electric Light Association, has entered the technical field, and is doing a good work in compiling and digesting the decisions of the courts and commissions upon matters relating to the public service regulation of electric properties. The publication supplements the work of the technical papers by calling attention to all important articles which such papers publish on the subject of rate regulation. It has been given a warm welcome, and the committee announces that it is already on a self-supporting basis.

BOOK REVIEWS.

Electric Arcs. By Clement D. Child, Ph. D. Size, 2½ x 7½ in.; 194 pages; 58 illustrations; cloth binding. Published by D. Van Nostrand Company of New York and for sale at The Technical Book Shop, 106 Rialto Bldg., San Francisco, Cal. Price $2.00.

The author of this book, who is professor of physics at Colgate University, has set forth in an orderly and logical manner the important points brought to light in modern experiments upon arcs. These experiments were performed between different electrodes in various environments. Thus the arc in air with carbon and other substances is treated followed by variation of pressures both greater and less than atmospheric. The mercury arc, the alternating current arc and the photometry of the electric arc are also discussed. A comprehensive index is appended. The work involves very little mathematical computation and the complete foot references are most useful.

Wiring Diagrams of Electrical Apparatus and Installations. Size: 5½ x 8½ in; 253 pages; 439 illustrations; cloth binding. Edited and published by McGraw-Hill Book Company of New York and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $2.00.

This volume contains a collection of circuit diagrams, representing more or less completely all branches of electrical engineering, with the exception of telephony and telegraphy. The diagrams, taken from actual practice, show much more than simple wiring connections. By their use it is possible to lay out a modern switchboard, to connect the apparatus and to understand the principles of operation of the various electrical machines. The book will be welcome to the engineering profession, for it will materially aid in standardizing present diagramatic methods. It will be found useful on the shelf library of every college drafting room and indeed in the drafting room of the modern engineering office.

Principles of Irrigation Engineering.—By Frederick Haynes Newell, Director U. S. Reclamation Service, and Daniel William Murphy, Drainage Engineer, U. S. Reclamation Service. Size, 6¼ x 9¼ in.; 293 pages; 117 illustrations; cloth binding. Published by McGraw-Hill Book Company of New York, and for sale by The Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $3.00.

This book is intended primarily for the use of students and engineers who desire to become acquainted with the general principles involved in considering the feasibility of, and in planning, constructing and operating irrigation systems. The book is written so as to be readily understood by the non-technical or practical engineer. Water supply, canals, drainage, reservoirs and dams are some of the leading subjects discussed. Illustrations and descriptions of many irrigation systems, with approximate cost estimates of different systems, combined with a discussion of water rights and economic features of irrigation, make the book a valuable one for the irrigation engineer.

INDUSTRIAL

INDUSTRIAL LIGHTING WITH SUNBEAM LAMPS.

The accompanying illustration gives an example of satisfactory and economical illumination by Mazda lamps and proper reflectors in the shop of the Cyclops Iron Works of San Francisco. This shop is 90 by 75 ft., with side walls 27 ft. high, and to clear the traveling cranes 500 watt clear Mazdas and R. E. D.-518 Holophane D'Olier enameled steel reflectors were suspended 22 ft. from the floor; installed in conduit boxes with circuit wires running in conduit, fastened to the iron truss work.

Six of these units are used 2 ft. 6 in. apart on the long side of the shop and 18 ft. 9 in. on the short side. Uniform illumination is distributed over 6750 sq. ft. of floor space at the consumption of 3 kw. or .44 watts per sq. ft.

Shop of Cyclops Iron Works, San Francisco.

From close examination of this photograph it appears that a certain amount of light is coming through the skylights, but this is not true, as the picture was taken at 6 p. m. on January 14th, when, of course, total darkness prevailed outdoors. It can be seen that the underside of some of the steel girders above the reflectors are lighted, which shows the advantage of having painted white side walls which diffuse a certain amount of light in an upward direction.

In the offices, drafting rooms, etc., tungstoliers, Holophane prismatic glass, xena veluria reflectors, with lower wattages of sunbeam Mazda lamps have been used, thus keeping the efficiency of the office and shop force during this rainy season on a par with that of the sunny days, and incidentally, lessening the possibility of accidents, which are liable to occur to mechanics who work in poorly lighted places.

EDISON STORAGE BATTERY STREET CAR AT MODESTO.

Edison storage batteries have been placed on one of the street cars in service between Modesto and Empire, running east of Modesto five miles to Empire. The trial run of the car was made on May 22nd, 1913, and E. M. Cutting, manager of the Edison Storage Battery Supply Co., went down to Modesto to see the car and charging plant put in operation. Several representative citizens made the trip. The run was made in 17 minutes. It was freely predicted by those who made the trip that this car is only the beginning of similar transportations to be provided at other places in the great level San Joaquin and Sacramento valleys.

RECORD-BREAKING CONSTRUCTION WORK.

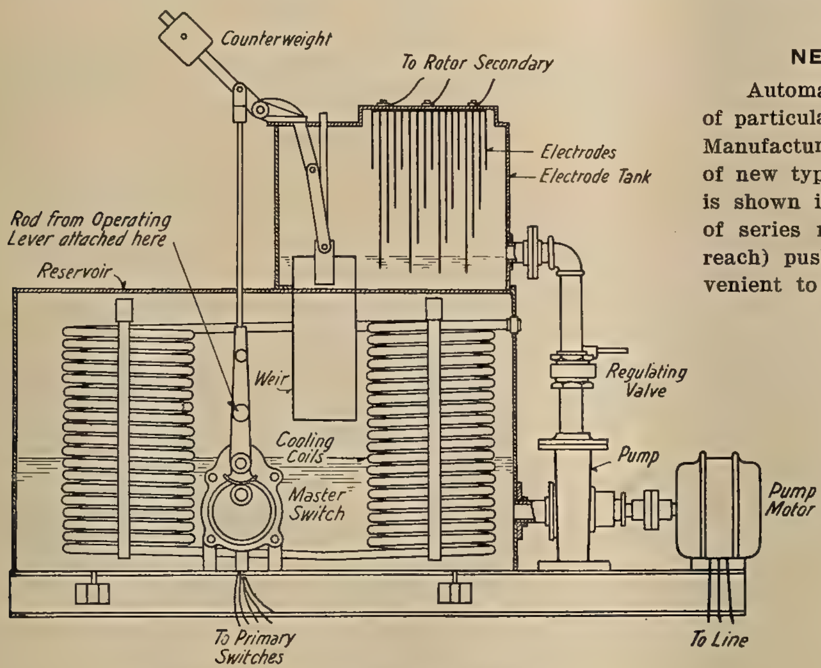
With less than a year having elapsed since ground was first broken, the large Canadian Pacific Railway shop plant near Calgary, Alberta Province, Canada, is now in full operation. Completely modern in character and one of the largest railway shops in the country, this plant was finished in just 351 days after ground had been broken. It was designed and built in its entirety by Westinghouse, Church, Kerr & Co., consulting and constructing engineers, and the speed with which the work was planned and carried to completion establishes a record for prompt performance.

The shops consist in general of main locomotive shop, tender and wheel shop, pattern shop and storage, foundry, storehouse and office buildings, oil house, coach repair and paint shop, planing mill, boiler and compressor house and miscellaneous structures. Complete service systems such as drainage, sewage, water-supply, etc., were also installed. Electric equipment is used throughout wherever possible, the

service being supplied by a power company's substation. This substation supplies alternating current at 440 volts. Direct current is supplied by two motor generator sets. Provision has been made in the boiler house for two incoming 2200 volt lines of 2,000 and 1,000 kw. capacity to supply breakdown service.

LIQUID RHEOSTATS FOR LARGE ALTERNATING CURRENT MOTORS.

The use of large alternating-current slip-ring motors for driving mine hoists, winding gears, rolling mills, etc., has created a demand for a simple, efficient and economical controller. To meet this demand the Westinghouse liquid rheostat has been developed. These rheostats provide an infinite number of steps between minimum and maximum limits, thus permitting fine speed adjustments and very smooth acceleration. The rate of acceleration can be definitely fixed and is independent of the rate at which the operator manipulates the starting lever; it is then impossible to injure the motor or the machine it drives by too rapid acceleration.



Sectional View of Liquid Rheostat.

The entire apparatus is simple in construction and reliable in operation. There are but few parts susceptible to wear or deterioration, and these can be easily and cheaply renewed.

The principle of operation of these rheostats is clearly shown by the accompanying diagram. The rheostat consists of two compartments, an upper tank for the electrodes, and a lower reservoir. The three phases of the rotor are connected to electrodes suspended in the upper tank. A small motor-driven pump pumps a steady stream of liquid, usually a solution of soda, from the reservoir into the electrode tank, and back into the reservoir over a weir. Now by raising or lowering the weir, the heighth of the liquid in the electrode is correspondingly varied. The resistance of the rotor circuit decreases as the liquid level rises, and vice versa, and the motor speed changes with the rotor resistance.

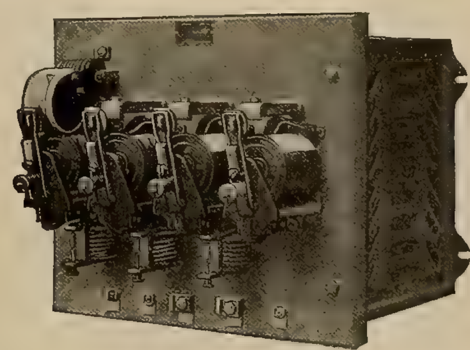
The primary circuit of the motor is closed and opened by means of electrically operated switches, which are controlled by a master switch mounted on the rheostat. The operating lever of the rheostat controls both the master switch and the weir. When the lever is in the central, or off, position, the primary switches are open and the weir at its lowest level, so that the secondary resistance is a maximum. Moving the lever in one direction closes the proper primary switches for starting the motor forward and raises the weir. Moving the lever in the opposite direction reverses the motor and again raises the weir.

A valve in the intake pipe of the electrode tank regulates the rate at which the liquid is pumped in, so that no matter how quickly the operating lever is moved, the liquid can only rise at the rate for which the valve is adjusted, thus fixing the rate of acceleration. When the lever is returned to the off position, the weir drops and the liquid level promptly falls.

Cooling coils in the reservoir prevent rapid evaporation of the liquid. These rheostats are made in capacities from 400 to 1500 h.p.

NEW AUTOMATIC MOTOR CONTROLLERS.

Automatic or remote control of motor-driven machines is of particular advantage in many cases. The Cutler-Hammer Manufacturing Company of Milwaukee has added a number of new types to its automatic controller line, one of which is shown in the accompanying illustration. With this type of series relay controller (which may be installed out of reach) push button switches can be used placed where convenient to the operator. The resistance in the motor circuit is automatically cut out and the motor accelerated, the starting current being kept at all times below a safe value. The magnetic switches close in succession controlled by the motor current through relays. These relays act to accelerate the motor quickly under light load, but when under a heavy load the resistance is cut out more slowly. In all cases the operator simply closes a small switch and the controller does the rest.



Cutler-Hammer Automatic Controller.

A smaller controller of this class having the new magnetic switches has a knife switch in place of the magnetic switch, the closing or opening of which is the only work the operator needs to do in starting or stopping the motor.

NEW OIL STARTING SWITCHES FOR SQUIRREL CAGE MOTORS.

Westinghouse Type T starters, which have recently been put on the market, are designed to supply reliable, economical, and sparkless switches for starting small squirrel cage motors directly from the line. They are for use in all industries and are especially applicable to textile and powder mills, and other pieces where all possibility of sparking must be eliminated. The contacts are immersed in oil and all parts except the handle are enclosed and protected from dust and dirt. Every part, however, can be readily exposed for inspection. The starters are made in capacities up to 10 h.p. for both reversing and non-reversing service and can be arranged for either hand or remote operation.

NEWS NOTES

INCORPORATIONS.

PORTLAND, ORE.—The Clackamas County Gas Company has been incorporated for $500,000, by A. L. Beatie, L. P. Hewitt and Frank E. Dooly.

SAN FRANCISCO, CAL.—The Gas & Electric Appliance Company has been incorporated for $100,000. S. P. Hamilton and W. T. Morris are the principal stockholders.

ILLUMINATION.

DINUBA, CAL.—At a meeting of the trustees the gas francise for the city was sold to A. A. Weber of the Alta Gas Company.

REEDLEY, CAL.—Bids will be received up to July 22 for the sale of a franchise for constructing a gas distributing system in this city.

VENICE, CAL.—The Southern California Electric Company has been awarded contract for lighting the entire canal district and providing ornamental concrete posts at $17,738.

BAY CITY, ORE.—A 30-year franchise to operate an electric light and power plant was granted at the regular monthly meeting of the Bay City Council to the Bay City Land Company.

TAFT, CAL.—The proposed municipal gas system for this city, will cost about $11,465, according to the report of City Engineer Abbey, which has been filed with the board of trustees.

SAN FRANCISCO, CAL.—The lighting committee of the supervisors has authorized the extension of the electric lighting system along Polk street, from Sutter where it now stops, to the civic center.

NEWPORT, CAL.—Bids will be received up to July 7th for a franchise granting the right to construct and maintain for a period of 40 years an electric system for transmitting of electricity for heating, lighting and power purposes.

TACOMA, WASH.—Bids will be received at the office of the commissioner of light and water up to 2 p. m., June 26, for furnishing and delivering f.o.b. Tacoma, all main transformers, disconnecting switches, oil circuit breakers and static arresters necessary for the completion of the substations.

TACOMA, WASH.—The city council of Tacoma has passed a resolution giving the Puget Sound Traction, Light & Power Company and the Seattle-Tacoma Power Company thirty days in which to discontinue the sale of electrical current for lighting purposes. It is claimed that the companies are selling current in violation of their franchises.

BAKER CITY, ORE.—The commissioners have authorized the employment of a competent engineer to prepare plans and specifications for the building and equipment of the new municipal lighting plant. The ordinance calling for the issuance of $25,000, 20-year, 5 per cent bonds for the construction, has been read for the first time.

SAN DIEGO, CAL.—Property owners of San Diego will be allowed to decide whether street lights shall be of cluster or single globe type of lamp. The conference decided that type of post used in single globe lamp now being tested in front of the city hall should be installed on all future lamps as being less cumbersome and more economical. It is adaptable to both cluster and single type of lamp.

OAKLAND, CAL.—Only one offer, from the Pacific Gas & Electric Company, was received by the city council for the electric lighting of streets. The bid is $11,000 per month. The failure of the Great Western Power Company and the Central Light & Power Company to contest after they had petitioned that the specifications be changed from a year contract to terms of three, ninee and twelve months, in order that they might bid, called forth a complaint from the Council.

LOS ANGELES, CAL.—Los Angeles' new scale of electric light and power rates go into effect July 1st. The new rates affect the Southern California Edison, the Pacific Light and Power and the Los Angeles Lighting Corporation. Already having the lowest rates of any of the larger cities, Los Angeles will have still lower rates when the new schedule becomes effective. Under the new schedule the electric lighting rate July 1st will be reduced from 6.5 cents to 6 cents a kilowatt hour and the power rate from 6 cents to 5 cents a kilowatt hour for the first 100 kilowatt hours consumed in one month. The reduction in rates affect about 75,000 consumers and will mean an aggregate reduction in rates of approximately $250,000 a year on the present basis of consumption.

TRANSMISSION.

PORTERVILLE, CAL.—Plans have been practically completed by the officials of the Mt. Whitney Power Company for a large addition to the equipment of their substation in Fourth street at Putman avenue.

PHOENIX, ARIZ.—All bids for construction of the new Crosscut power house were rejected. Some misunderstanding had arisen regarding certain additional concrete work that may become necessary. New specifications are now being prepared.

ABERDEEN, WASH.—A petition signed by the business men of the city has been presented to the city council of Aberdeen, Washington, asking for investigation as to the feasibility of a municipal lighting and power plant at the head waters of the Wynooche River. The proposed plant is estimated to cost about $900,000.

RICHMOND, CAL.—The Great Western Power Company has announced that it will begin immediately to extend its lines into Richmond, Rust, San Pablo, Pinole and Dodeo in accordance with terms of the franchise recently granted the corporation by the county supervisors. The company proposes to build 159.39 miles of new lines, costing $200,000, in Contra Costa county.

FRESNO, CAL.—The announcement is made that the four dams of the Big Creek power plant of the Pacific Light & Power Company are now completed. The work on power house No. 1 has reached the fourth floor and the foundation has been laid for power house No. 2. The first tower from the Big Creek plant will go out over the No. 1 line about July 1, according to the latest estimates, although the plant will not be completed so that the two power houses can be operated to capacity until about the first of the year.

MONTPELIER, IDAHO.—The Utah Power & Light Company has completed negotiations and made the initial payment for the Bear Lake Power Company of Montpelier, Idaho. The latter will perfect its title before the property passes. The consideration was in excess of $100,000. The property consists of two plants, one at Georgetown and another at Paris. The company furnishes light and power for Montpelier, Bloomington, Georgetown, Bennington, Ovid and St. Charles, Idaho.

VISALIA, CAL.—The Mt. Whitney Light & Power Company is at work preparing plans for the Tuolumne Light & Power Company project. It is announced that work probably will begin this summer. The Tuolumne Light & Power project, subsidiary to the Mt. Whitney Power & Electric Company, will generate power from the north, middle and south forks of the Tuolumne River in Tuolumne county. Akerson,

East and Stone meadows, adjoining, will be used as reservoirs. In two instances the intake ditches run into the Yosemite National Forest Reserve. The main ditch from the reservoirs leads 14 miles to a point below Groveland, where a drop of 1400 feet is used to generate power. The project will cost close to $2,000,000.

SEATTLE, WASH.—Federal Judge Edward E. Cushman of Washington in a recent decision canceled patents to six mineral claims held by the Whatcom County Railway & Light Company, a Stone & Webster corporation on the Nooksack River in Whatcom County. The decision restores to the government a continuous descent of water approximating 300 ft., including power sites. The decision also deprived the claimants of a completed water power plant on the same river where the river drops 173 ft.

TRANSPORTATION.

TULARE, CAL.—The last gap, a half-mile stretch, in the right of way from Tulare to Woodville, has been secured by the Big Four Electric Railway, and grading work on this stretch will be concluded at once.

WASHINGTON, D. C.—Street car lines are not subject to regulations of the Interstate Commerce Commission. The Supreme Court has so decided in annulling the Commission's order for a 5-cent reduction of the fare from Omaha, Neb., to Council Bluffs, Iowa. Judges Sanborn, Hook and Adams of the United States Circuit Court held that the Commission did not possess the power to regulate street railways crossing State lines, while the Commerce Court held that it did.

RICHMOND, CAL.—The Southern Pacific Company is about to extend its electric service into Contra Costa county, and has completed the survey and purchased the right of way for a line extending from one of the Berkeley branches through the foothills into San Ramon Valley, where it will connect with the steam line running from Avon through Walnut Creek to Livermore. The projected line parallels the Oakland, Antioch & Eastern through the hills into Redwood Canyon to a point a little east of Lafayette, where it swerves to the south and joins the San Ramon branch at Alamo. Work on the line is to be commenced without delay, according to agents of the company.

TELEPHONE AND TELEGRAPH.

VANCOUVER, WASH.—The petition for a franchise from the Southwestern Washington Telephone Company, has been granted.

ALTURAS, CAL.—Bids will be received up to July 21, for the sale of the franchise for a telephone and telegraph system in Modoc county.

WHITTIER, CAL.—It is rumored that the Whittier Home Telephone Company will extend its lines in the Happy Valley district, and also into North Whittier Heights.

SAN FRANCISCO, CAL.—The 6 per cent bonds of the Sunset company, maturing July 1, will be paid at the Wells Fargo Nevada National Bank. Against the outstanding issue of $750,000 there was deposited in the sinking fund on February 1, 1912, $661,906. A formal offer is made to exchange these bonds, par for par, for Pacific Telephone 5s.

CLOVERDALE, CAL.—Commissioner Loveland has rendered a compromise decision on the application of the Cloverdale Light and Power Company for leave to sell its plant to the California Telephone and Light Company. The application was granted on condition that the company should within five years expend $25,000 in new construction. The application for permission to issue $75,000 in common stock was withdrawn and authority was granted to issue bonds in the sum of $75,000 and $50,000 of preferred stock. The California Telephone and Light Company is to pay the Cloverdale Company $75,000 cash for the plant.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company has brought suit in the U. S. District Court against Mayor Rolph and the Supervisors to prevent the enforcement of the two telephone rates ordinances that go into effect July 1. Judge Morrow has set the hearing for June 23. The telephone company will ask that a temporary injunction be followed by a permanent restraining order. The claim is made that the rates provided in these ordinances are "confiscatory" and conflict with the terms of the Federal constitution, which guarantees no person shall be deprived of property without due process of law. The telephone company states the valuation of its plant May 1, 1912, was $18,406,430, and it states that the estimated operating expenses for the fiscal year ending June 30, 1914, will be $2,761,630. It speaks about this expense as well as the charge for constant depreciation, and insists that the telephone rates should be fixed so that the corporation may be assured a gross income of $4,959,240.

WATERWORKS.

EL CENTRO, CAL.—Citizens of this city have voted for the issuance of $50,000 in bonds to extend the domestic water system to cover the newly built up portions.

SPOKANE, WASH.—Bids were opened for the installation of trunk water mains in Hillyard and the contract was awarded to the James Kennedy Construction Company for $30,973.03.

TWIN BRIDGES, WASH.—Bonds in the sum of $17,000 have been voted, the proceeds to be used for the construction of a water system which includes 150 ft. of stand pipe, mains and deep well.

PETALUMA, CAL.—The proposition to issue municipal bonds in the sum of $375,000 for the purchase and improvement of the plant of the Petaluma Power & Water Company was defeated by the voters.

BILLINGS, MONT.—The Montana Water Company vs. the City of Billings is a suit filed in the federal court. The plaintiff seeks an order to restrain the city from selling $575,000 worth of bonds for the purpose of constructing a water system for Billings.

OLYMPIA, WASH.—A special election will be held July 21st to submit to the voters the question: "Should the City of Olympia acquire and operate waterworks for the purpose of supplying the city and inhabitants with an ample supply of water, including water power derived therefrom."

BAKERSFIELD, CAL.—An application has been made to the Board of Supervisors by W. N. Bundock for a franchise to construct and operate a distributing system comprising a water plant and system in the town of Wasco, for a period of 50 years. Sealed bids will be received for the sale of the franchise up to July 9, 1913.

NEVADA CITY, CAL.—The Birchville Mining Company has been granted permission to file a notice of location appropriating 250 miners' inches of water of Lake McMurray and Weaver Lake, belonging to the Northern Water & Power Company. The Birchville Company contemplates the erection of a power plant on Weaver Creek.

SAN FRANCISCO, CAL.—Patrick Calhoun, president of the Solano Irrigated Farms, Inc., has engaged Professor Hyde of the University of California to take charge of and erect at once a complete filtration and sterilization plant for furnishing water to the new city of Solano, the city of Suisun and the surrounding country. The water will be taken either from the reservoir or irrigation canal on the Solano Irrigated Farms and will not only be filtered but will also be sterilized. A plant with a capacity of 20,000 gallons per minute will be erected at once with arrangements for larger facilities as required.

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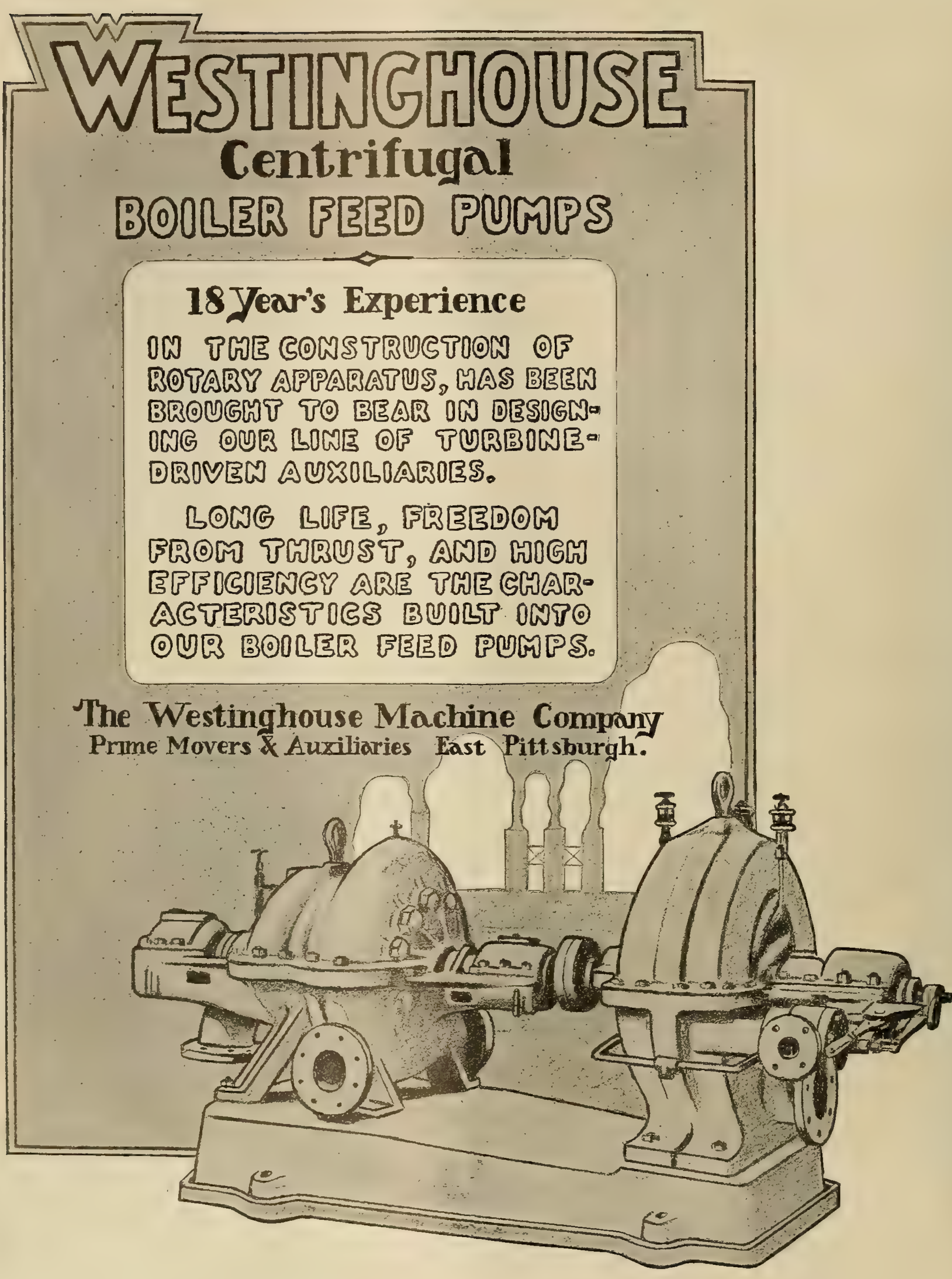
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THE WHITE SALMON RIVER DEVELOPMENT

BY WILBUR B. FOSHAY.[1]

The Northwestern Electric Company, a corporaation, made up of San Francisco and Portland capitalists, and with the main offices located in Portland, Oregon, has completed and put in operation a power plant on the White Salmon River, at a point about three miles above the point where it empties into the Columbia.

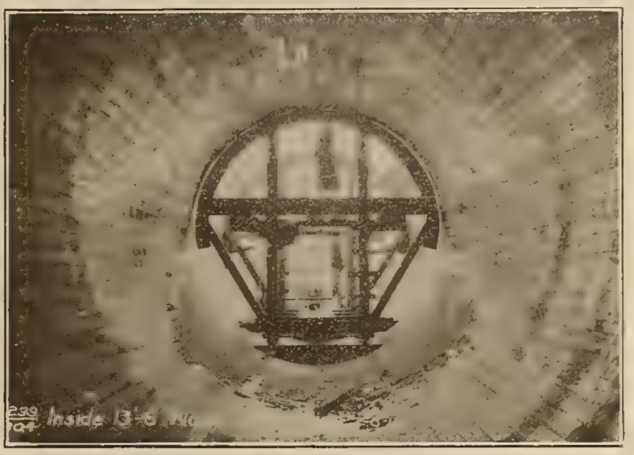
In order to make this development it was first necessary to construct a road along the hillside from Underwood Station, on the North Bank Railroad, to the site of the proposed power house and dam, a distance of about three miles, and in order to cross the ravine through which the White Salmon River flows, a bridge about 115 ft. long and some 90 ft. above the river was constructed. This bridge had to be constructed strong enough to carry all of the power house equipment, which of a necessity must be hauled over it.

A view of the Dam in the White Salmon River Development.

The dam proper is about one mile above the power house site and is constructed between two stone walls of natural formation, being at a point

[1]Manager of the Northwestern Electric Company.

where the river flowed through a deep cut. This dam is 60 ft. long at the bottom and 470 ft. at the top. It is 96 ft. through at the bottom and 15 ft. at the top. The height of the dam from bed rock is 125 ft. and the dam contains about 30,000 cu. yds. of concrete. During the construction of this dam there was located on the hillside above the dam site rock crushers and sand machines. The rock was taken with scrapers into the rock crushers and crushed to the proper size, a portion of this rock then going by gravity into the sand machine and



Looking Through the Large Wood Stave Pipe.

being ground into sand. This in turn was carried into the mixer by gravity where cement and water were mixed in with the sand and crushed rock. The concrete thus made was carried by gravity to its proper place in the dam 100 ft. below. In this way after the material entered the rock crusher it was not touched by human hands again, but carried by its own weight through the various processes in troughs to its proper place in the dam.

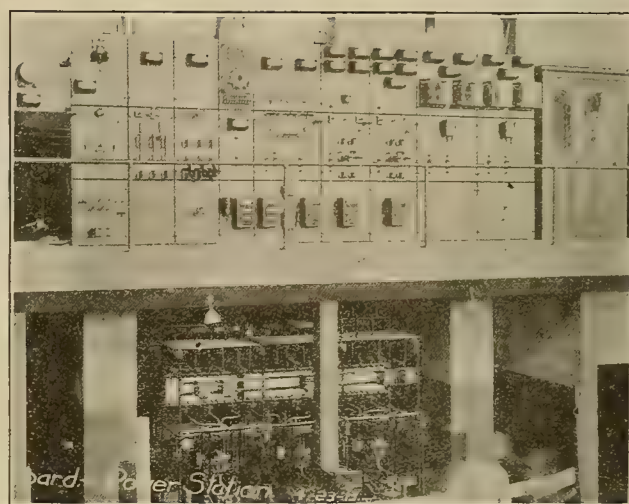
From the dam site to the power house, one mile below, the water is carried in a wood stave pipe 13 ft. 6 in. in diameter, which pipe is the largest wood stave pipe of which any record can be found. This wood

The Power Station.

stave pipe was constructed and installed by the Pacific Coast Pipe Company. This large wood stave flume is constructed on a hydraulic grade the pipe resting in cradles set on concrete foundations, these cradles being about 4 ft. 6 in. apart. At a point about 700 ft. from the power house it is reduced to two nine foot pipes, which at a point some few hundred feet nearer the power house are changed to a steel riveted construction and these steel pipes continue to the power house proper.

The power house itself is located directly on the river bank and a working head of 177 ft. is secured. The power house proper is of concrete and steel construction; the building being approximately 70 by 150 ft.

The water wheels are of the Francis turbine type manufactured by the Allis-Chalmers Company. There are two water turbines to each generator; one turbine being located on each side of the generator. The entire unit made up of the two turbines, and the generators which are Allis-Chalmers machines, are carried on two bearings, one on each side of the generator, the shaft extending through the discharge pipes of the turbines, which are one-quarter turns, and in which are located thrust bearings, so that while these bearings carry no weight in the operating of the units, in case it is necessary, either unit can be taken down and the other unit can operate the generator. Thus during a repair to one turbine unit, only one-half the capacity of the generator will be lost. There are two such installations with a capacity



The Switchboard of the Power Station.

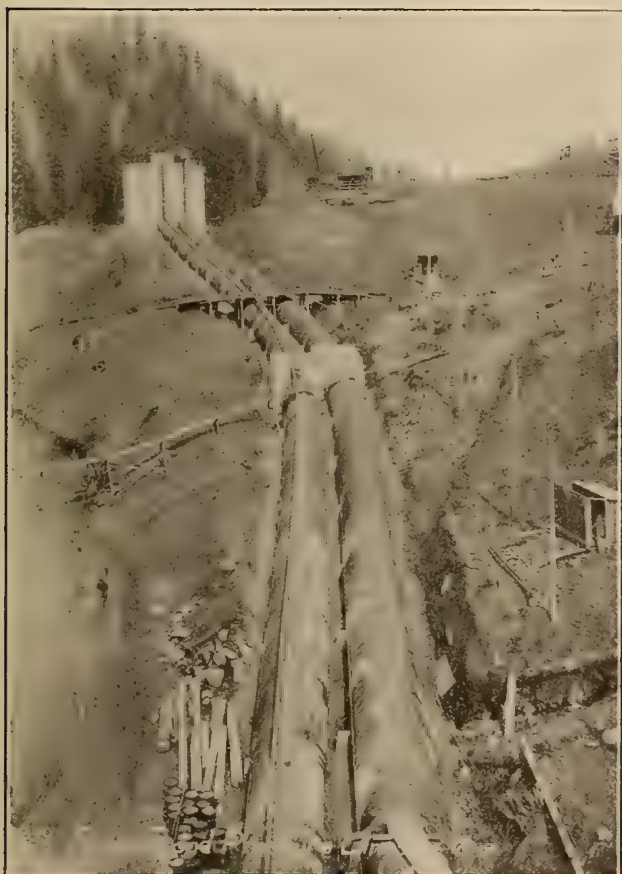
of about 10,000 horsepower each installed in this power plant, and with the generating units made up as explained, the plant can be operated at the greatest efficiency at one-quarter, one-half, three-quarters or full load.

In the same power house are located the transformers for stepping the current up from 2300 volts, at which it is generated, to 60,000 volts for transmission to the city of Portland. The switching apparatus and auxiliaries are also situated in this power plant. The transformers and switching apparatus in this plant was furnished by the General Electric Company.

From this power plant to the river crossing at Camas, the pole line is completed and is in operation to Camas, at which point 4000 horsepower are now being served to the Crown Columbia Paper Mill; this being one of the largest paper mills on the Pacific

Coast. At Camas the pole line will cross the Columbia River, the towers for this line now being in place and completed. The tower crossing consists of five supporting towers and four strain towers, the height of these towers being 140 ft. The material for the construction of this line into the city of Portland has all been ordered, and is in the course of shipment at the present time, as is also the equipment for a steam auxiliary plant to be located in the heart of the city of Portland, in the new Pittock Block, where will also be located the direct current converting station. This steam auxiliary plant will have boiler capacity sufficient to carry the two 3750 kw. General Electric turbines that have been ordered for installation in this plant.

There is now before the city council of Portland, a steam heating franchise of the Northwestern Electric Company, and after the passage of this franchise the company will proceed to install a central steam heating plant, securing the steam from the auxiliary plant herein referred to, and distributing it in the main business sections of the city, it being the idea of the company to install its heating and underground conduit at the same time.



Forebay and Pressure Pipe Lines.

The entire system, including power site, pole line and steam plant in Portland, has been located and designed under the direction of B. C. Condit, a San Francisco engineer. The hydraulic development was made by the Stone & Webster Engineering Corporation, on contract, and was in charge of Mr. J. H. Manning of that company.

STATE AND NATIONAL CO-OPERATION IN THE DEVELOPMENT OF OREGON'S WATER RESOURCES.[1]

BY FRED F. HENSHAW.[2]

A society emerges by slow degrees from the state of barbarism and the lower developments of civilization to the high plane of the civilized state in the twentieth century, it puts to use new agencies to satisfy the many new requirements to its well being. Primitive man may subsist in a forested region dependent on the chase. The more primitive forms of transportation and communication are called upon for service and a few animals are domesticated for man's use. At a later step in his advance comes the use of the land for agriculture. The employment of mechanical power as an aid to development of civilization comes as a relatively late step. Yet beyond a certain point there is hardly any one agency which contributes more largely to man's social well being than the application of mechanical power. Few indeed are the occupations which do not require it in some form. It is essential to the development of transportation, except where horses or other animals are used as a motive power. In our present complicated society mechanical power has become just as essential in agriculture as it is in manufacturing or transportation.

Along with the development of its uses the means of generating and distributing mechanical power have grown apace. Without going back farther than a few decades we have grown from the use of the isolated water power and the inefficient steam engine to the utilization of prime movers of the highest efficiency and the distribution of the power generated by them through scores of hundreds of miles by the aid of high tension electric currents. The present rapid development of long distance transmission of water power dates back hardly more than 20 years, and it has received its most effective impulse from improvements within the last ten.

The problem of the proper governmental policies in regard to the generation and distribution of hydroelectric power have only just been brought forcibly to the attention of the body politic, and yet at present there is almost no question of greater importance. The problem is made more acute, especially in some localities, by the relatively limited amount of the source of primary power, and presents different phases in different portions of the United States. The coal fields of the country appear at present almost limitless in extent and yet, they are not inexhaustible by any means. Scientists tell us that there is a sufficient stock of fuel for perhaps the next 150 years. No one can predict, however, the rate of future growth of power utilization and consequent depletion of the supply of fuel.

In the case of hydraulic power the source of energy is perpetually renewed but in a great many portions of the country the supply of potential water power is limited and even at present could not supply

[1]Read before a joint meeting of the Commonwealth Conference and Oregon Society of Engineers, at the University of Oregon, Eugene, May 17, 1913.

[2]District Engineer, U. S. Geological Survey.

the demand alone. Thus in the central portion of the great Mississippi Valley there is only one power site of large magnitude which has been considered feasible of development at the present time.

On the Pacific Coast the water power resources are relatively most abundant and apparently there will be no need of fully developing them for several decades to come. It has been estimated by the commissioner of corporations that approximately 11,500,000 or 43 per cent of the total estimated potential power of the country is found in the three Pacific Coast States of Oregon, Washington and California. This total, of course includes many powers that are not and may never become commercially feasible. The potential power of Oregon streams has been estimated at over 3 million horse power while the total amount of power used in the State of New York today is probably not over one-third of this amount. Problems of cost of development, distance from market. and interference of high water, serve to make many potential power sites unfavorable for development at the present time, and materially reduce the amount of power actually available. As a matter of practical economy therefore, it is impossible to consider water power resources as by any means unlimited.

The generation and distribution of electric power is a function similar in nature to the supplying of water to a community for domestic use, or the furnishing of transportation by railroad and street car lines. All come under the category of natural monopolies as the service is rendered in connection with the plant itself and cannot be separated from it. The conduct of these natural monopolies for public service is essentially a governmental function, but in the past the government has in most instances seen fit to turn over the actual handling of these to private enterprise.

The supplying of water for irrigation is likewise a public function. The national and state governments were slow to recognize this truth but a little over ten years ago it was accepted as a part of governmental policy and the United States Reclamation Service was organized to actively prosecute the construction of irrigation work. In its relatively short career the Reclamation Service has placed irrigation development on a much higher plane and a much more permanent basis than was the case before its inception.

Private companies engaged in the conduct of a public utility, such as transportation, irrigation, or water power development, must in the nature of things look for direct returns on their capital invested. Most companies cannot afford to wait for a long term of years to see these returns come in. Of course there are notable instances where railways have been built through an undeveloped country with a view to aiding in its development and have not expected to receive adequate returns on their investment for many years to come. The same is true in the case of many power companies which have extended transmission lines into relatively new areas which promised to develop power markets with sufficient rapidity to ultimately more than repay the cost of service. Capital is naturally timid, however, and there are instances where the development of large areas of favorably situated country have been held back for long periods through the failure of private capital to properly look ahead to the future. Were the government engaged in these activities they would not look merely at the direct or immediate returns, but could look ahead to the more distant future and could consider the indirect returns in the increase of taxable wealth and the development of the country as a part of their remuneration for the money spent.

Government control (using the word government in its broad sense to include both state and national), would also be conducive to the highest use of the resources of the State. A power company, when it seeks a site for development, does not question whether the water could be better used for irrigation or whether the use to which they are putting it is the highest. They consider merely its adaptability to their own particular purposes. The question of the relative utility of our water resources is one which will in the future become very pressing. With a well constructed policy on the part of the State, future conflicts of use can be avoided and the ultimate greatest benefit of all served can be attained.

An argument for control by the Federal Government is the desirability of uniform regulation all over the country. Oregon and Wyoming have water laws which probably represent the highest degree of development in this country. Many states have systems of water titles which are much less perfect. In some of them the water rights are nothing short of chaotic. This is decidedly the case in Washington, for instance. Uniform regulations would work to the special advantage for such states. All complications arising on international streams, must of necessity be handled through the federal authorities.

Thus far the activities of the State and Federal Governments, so far as they have been turned to power development, have merely sought its regulation. Neither governmental agency has a free field in the control. The states at present control the rights in and the distribution of the water within their borders and many, like Oregon, have by legislative enactment provided a code of water laws. Most lands that have not yet passed into private ownership are still retained by the United States. The Federal Government also exercises control over navigable waterways, and as a necessary part thereof, appears to hold some measure of control over the non-navigable tributaries of these streams. Most of the states have sought to establish some degree of regulation over power development. In Oregon this is provided for in the water code by the provisions of which parties desiring to develop power must secure the permission of the State authorities.

The control of the Federal Government over power development has been exercised in two ways—first, by requiring that permission shall be secured for its development on navigable streams. Such permission is granted by a special act of congress and the development is then under the general control of the Secretary of War. In the case of power development on the public lands and reservations of the United States the Federal Government acts in the role of landlord. The statutes provide for the granting of rights-of-way for the construction of irrigation works which are in the nature of easements. For the development of power a permit is granted which, under the present enactment, is

revokable at the will of the Secretary. Under this law, generally known as the Act of 1901, the Secretary of the Interior, and the Secretary of Agriculture have issued regulations for power development on the public lands and in the forest reserves respectively which are essentially identical. These regulations provide for the issuance of permits which shall terminate at the expiration of 50 years unless previously revoked and the payment by the permittee of a nominal compensation for the use of the power site. This charge increases gradually from year to year and is made smaller for power sites which require long transmission lines to centers of distribution. These regulations provide for the revaluation of the permit at the end of each ten years and readjustment of the rates charged.

In the consideration of the question of the proper charges for the use of public power sites it would appear that the basis of the charge might be taken as the rental value of the site. The economic law of rent applies to water powers just as truly and with many of the same limitations as it does to land. The rental value of a water power site is measured by the difference in cost of developing power at that site and at the next site which must be utilized to supply the market, or the difference between the cost of development at the site and from fuel. As the demand for power increases and as other and still less favorable power sites must be used the rental value of any particular site increases just as the value of land increases. It has been proposed by some political economists to make this increment a basis of taxation. At any rate, it would seem that the charges for the use of power sites owned by the public and leased to private corporations should ordinarily be limited by the rental value of the site. It has been contended that the imposition of such a tax would tend to place the burden of its payment upon the consumer of power and that its removal would tend to decrease power rates. The laws of economics teach us that this is not the case. If the rent is remitted it is in the nature of a gift and it would be very difficult to force the power company to pass the gift on to the consumer.

The selling price of power may be divided into three component parts—first, the cost of actual delivery of the power at the switchboard of the station, which may be called the generating charge; second, the cost of distributing; and third the commercial charge which includes the maintenance of the power companies organization; the accounting of collection departments and similar expenses. For the bulk of the power sold especially for lighting, the distributing and commercial costs are greater than the generating cost. The rent of the power will be added to the generating cost and in general will be lost in the greater amount of the commercial charges, and will have little if any effect on rates. For power in large quantities the rental charge is relatively larger in proportion to the selling price.

Thus far I have been discussing particularly the situation in regard to water power development. Closely allied with the developments of water power and of fully as great interest to the people of the State as a whole are the proper conduct of irrigation works and the policy which will conduce to their highest utility.

It has been estimated by the conservation commission that, leaving out of consideration Columbia River and the streams of the Coast Range, the rivers of Oregon discharge annually about 40,000,000 acre-feet of water and that of this amount practically 9,000,000 can be ultimately utilized on the land for irrigation. This will mean at least 3,000,000 acres of land brought under cultivation. A large percentage of this land is now of little use for agriculture and the productivity of all will be increased many fold by the application of water. In 1909 the census returns showed that there were actually under irrigation in Oregon pratically 700,000 acres, probably including large areas of land partially watered, and this area has no doubt been increased considerably since that date. Practically 60 per cent of this has been watered by small ditches constructed by individual and partnership enterprises, and generally watering land in the immediate vicinity of a stream without the aid of extensive engineering works such as storage reservoirs, diversion dams and long canals. The possibilities of additional irrigation on this scale are limited and further development must come by the building of large projects, of tens, or even hundreds of thousands of acres. Many such projects have been taken up in the past by private companies and under the provisions of the Carey Act.

Of the various projects which have been undertaken by the State, under the Carey Act, a number have either foundered on financial rocks or at least, have been reorganized, often more than once. These difficulties have generally been due, according to the Oregon Conservation Commission, to one or all of five causes:

1. An unduly heavy initial incubus upon the project, for promotion and organization expenses;
2. Inadequacy of the water supply;
3. Lack of complete engineering plans and reliable estimates of cost;
4. Lack of adequate financial backing;
5. Inexperience and mismanagement in handling the enterprise and colonizing the land on the part of both promoters and State officials.

It is not likely that the same mistakes will be made to the same extent in future work. There are, however, certain inherent difficulties in the way of successful irrigation development on a large scale by private capital. The returns on the original investment are necessarily slow in coming in, possibly two to five years are needed in gathering stream flow and other engineering data, and two or three years more are occupied by construction work before the payments by the settler begin. The land may be settled up slowly, in most large projects this has been the case, and altogether it may be two or three decades before the original investment is repaid. In the meantime the interest charges on a commercial project must be paid promptly or the developing company will be thrown into the hands of receivers. In any event, capitalists are not eager to undertake to finance construction if they must wait so long for returns on their outlay. In the ordinary mercantile business, the total capital may be

turned over perhaps twice in a year, each time with profit. Experience has proven that capitalists are not willing to wait so long a time for returns on their outlay. In a mercantile business the total capital may be turned over perhaps twice in a year, each time with profit. Even in the case of a railway, which is much more nearly analogous to an irrigation project, the net earnings may reasonably be expected to pay dividends almost from the first. But in irrigation the returns are delayed for years, and interest, maintenance, and selling charges are magnified. Under these conditions it has been found to be impossible to interest capital and to insure it a reasonable profit, unless the selling price of the land is fixed at a figure at least double the estimated cost of construction.

If the percentage of profit is increased, to encourage capital to invest, the increased cost of land works a hardship on the settler, retards development and tends to defeat the very object which it was desired to attain with the increase. Often as a result of the attempt to keep down the cost of land and still allow profits, the construction has not been carried out in accordance with sound engineering practices, with resulting poor service to the irrigator, hard feeling, disputes, losses and annoyances.

Conditions in the valleys of Oregon were, in a way a little too favorable to lend themselves readily to irrigation development on a large scale. The land was sufficiently productive to support a small population under dry farming methods, or with flood water irrigation in the spring, and it had been for the most part taken up before the Reclamation Service and the large irrigation companies entered the field, and the settlers being able to make a precarious livelihood under existing conditions, were loth to place a lien on their lands to assure a permanent water supply. In the other Western States, there were at the same time vast tracts of arid sage brush land, almost entirely in public ownership which were admirably adapted to the workings of the Reclamation Act and on which successful projects have since been worked out.

The State of Oregon is interested in the development of its irrigable lands as a means of increasing its population, its taxable wealth, and the general well being of its citizens. Governments have often undertaken land reclamation projects without any thought whatever of direct return. Thus the British colonial government in India has undertaken the building of many protective irrigation works, as they are called, which in years of drought will save the crops from failure and the people from want and starvation.

In Canada the Canadian Pacific Railway is undertaking the reclamation of three million acres of land with no idea of profit, except indirectly through the increase of freight and passenger traffic.

In Australia, not only the private promoter but also the land speculator has been compelled to step aside for the good of the State. Before public funds are invested in an irrigation enterprise, the dry farm lands are purchased at dry farm prices and after being irrigated by the State, are sold to actual settlers at practically cost of land and water.

It would seem then, that since private agencies have fallen short of the full measure of success in prosecuting irrigation development, the State might well actively undertake the work. As in all engineering work, thorough investigation should precede actual construction. The first step to be taken should be those usually taken by the promoter, the making of preliminary and final surveys, studies of water supply, plans and estimates of cost. The public, should in effect, become its own promoter, acting through some suitable public official, protecting itself during the period of preliminary work by withdrawing the necessary water from the operation of its water laws.

At least two alternatives present themselves for handling the actual construction. The State might assign its water rights and sell its plans and estimates to such persons or corporations as will carry out the projects at a minimum cost to the water users and in accordance with plans and regulations approved by the State. Such contracting parties would reimburse the State for the cost of the preliminary studies. This procedure might well be followed in the case of small projects without complicating features.

With the larger and more costly projects, the State may find it advantageous to carry out its own plans. Being able to borrow money at a lower rate of interest than a corporation, and working with no idea of direct profit it would be able to furnish water to the farmer cheaper than could a private company. The work would be prosecuted solely with the idea of rendering the best service, and building in the most substantial manner, and the final results would be more satisfactory than any company would be likely to achieve.

It was suggested that should the latter plan be undertaken, the State co-operate with the United States Reclamation Service in carrying on this work. The first steps in this direction have already been taken. The last legislature appropriated $50,000 for the investigation of the water resources of the State with special reference to the possible irrigation and power projects on Deschutes River and its tributaries. These studies are now being carried on by the U. S. Reclamation Service which has allotted an equal amount of its funds for the work.

The Deschutes project presents irrigation and power possibilities of unusual magnitude. Just to what extent these possibilities will materialize will depend largely upon the results of the investigations now under way. Deschutes River at Benham Falls above all diversions has a mean yearly runoff of about one and one-quarter million acre-feet. There are available at least 5 reservoir sites for conserving this water and holding the winter flow over until the irrigating season. The largest of these sites located on the main river at Benham Falls has a capacity of 700,000 acre-feet with a depth of water at the damsite of 66 feet and appears to be one of the most favorable sites on the Pacific Coast. The water supply from Deschutes River at this point is sufficient, it has been estimated, to irrigate 390,000 acres. From Tumalo Creek 30,000 or 35,000 acres can be covered. The Tumalo project has already been taken up by the state and construction work toward its completion will be started this summer. On Crooked River there are at present very large areas under water and this area can be very materially increased by storage. With the flow of all the head waters of the river stored

and used for irrigation there would still be a sufficient discharge through the lower canyons from springs and tributaries to generate practically half a million horse power. The Deschutes project as a whole, is altogether too large to lend itself to private development. It is also one which will require careful planning in order that the highest use of the water may be attained. The construction of one or two power plants in the middle portion of the river might involve the creation of water titles which would delay for years the full development of the irrigation possibilities from the stream above and perhaps prevent such full development altogether.

There are other portions of Central Oregon which present conditions fully as favorable as the Deschutes basin for the direct State control of waters. Take for instance the portion of the State from which the streams have no outlet to the sea and which is therefore included in the great interior basin.

In this sparsely settled country the power market and agencies of distribution are yet almost wholly undeveloped, but with the coming of railroads and the development of agrictultural lands a large population will eventually settle there. Electric power will be necessary for municipal use, for traction, and to a very large degree for irrigation. Conditions in many of the valleys in Central Oregon are such as to readily adapt themselves to irrigation by pumping. Most of the streams rise in high mountains surrounding the valleys, and fall rapidly to the border of the hills, then meander with almost no fall through the valley to the lakes in which their waters are lost by evaporation. Canals to conduct the water direct from the streams to the land would involve heavy construction work in the hills while in some of the valleys the gradients are not sufficient for a proper distribution of the water. With electric power available the water can be raised from the streams near the point where it is to be used and distributed in relatively short and cheap canals. It is probable that pumping will play an important part in nearly every project in the interior basin area of southern Oregon, and also in the drainage basin of Klamath River. In this whole area water is relatively scarce. The streams are small and have a very irregular flow and there are only a few localities in which the fall is sufficiently concentrated to make power development cheap and easy. It is especially necessary that the power resources should be conserved and developed to their fullest capacity and applied to the highest use. The maximum utility can be achieved only by a systematic development of these resources by a unified organization.

The pumping of water for irrigation has thus far been carried out only in a limited degree. Rates for power have generally been high, necessarily so because the pumping plants have usually been in small units, distant from one another, the demand for energy has been intermittent and extends over only about half the year at most.

In some places under favorable conditions the sale of electric energy for pumping, may be put on an entirely new commercial basis. Either the power must be furnished continuously throughout the greater portion of the year and the water stored in reservoirs when it is not needed, or the plant must be adapted to using the surplus energy of the power plant at off peak periods when a part of the installed machinery would otherwise be idle. The heights to which water can be pumped under the conditions which have generally prevailed is limited to 100 or 150 ft. With the plant pumping continuously throughout the year using energy at the very low rate at which this would warrant, and storing the water from winter to summer, if feasible reservoir sites exist, it is probable that the lifts could be doubled without increasing the cost beyond what the present value of irrigated land would warrant. Take for instance the lands along lower Snake and Columbia Rivers within two or three hundred feet above the water level. These lands all have a mild climate; are convenient to both railroad and water transportation, and in general have excellent soil. If these were all placed under cultivation the wealth of both Oregon and Washington would be increased to a very large degree and thousands would be added to the population of the two States. The development of these lands may come gradually under private power developments. They should certainly proceed much faster with the lower cost of power that would prevail with development by the public.

The power and irrigation projects which are being developed are becoming more and more of an interstate character. Thus the Northwestern Electric Company is developing power in Washington for sale in Oregon. The Washington Water Power Company of Spokane sells power from its Washington plants to the mines of Northern Idaho. The transmission lines of the Pacific Power & Light Company cross from Washington to Oregon and power generated in either state can be used in the other. The interstate sale of power is a phase of interstate commerce and this becomes a matter of interest to the Federal Government. Some irrigation projects are wholly interstate; others involve the storage of water in one State for use on lands in another, as is the case on Jordan Creek and Sucker Creek on the boundary line between Oregon and Idaho. No one State working alone could adequately manage these interstate projects. It would require co-operation between the two States involved and the Federal Government.

Co-operation between state and national agencies is by no means a new or untried departure. The geological and engineering departments of this and other states have been co-operating for years with the United States Geological Survey. Last year the State of Oregon and the Geological Survey each contributed $28,000 for investigations of river discharge and water powers, and the making of topographic maps, and this year it is proposed to spend an equal amount. Many states have co-operated with the United States Department of Agriculture in irrigation studies, soil surveys and other allied investigations. Local agencies like the Port of Portland have been working along with corps of engineers of the War Department in the improvement of river and harbor for navigation.

The relative advantages claimed for federal and state control of water power and irrigation development may be briefly outlined. The engineering and allied bureaus of the Federal Government have had a

permanent organization which has been maintained over a long period of time. The U. S. Engineer Corps has been charged with the improvement of rivers and harbors for about a century. Other bureaus have been organized for a shorter time but all have been operating sufficiently long to have methods of work well perfected. The government departments are under civil service regulations which insures the permanency of personnel and efficiency of organization. But the government bureaus are criticized and often justly for an excessive amount of red tape and bureaucratic methods and the failure to adapt themselves to local conditions. The state organizations are nearer to the people both physically and in their point of view. They are more responsive to public demands, and are more easily adapted to special requirements. The state bureaus have more often been under the baneful influence of partisan politics and have often been subjected to the disadvantage of frequent changes in personnel. The question as to which agency, state or national, should have the direct handling of any public development of power or irrigation, is not one of theory but of actual practical efficiency.

The results of the exploitation of natural resources by private corporations, in the past, have not been wholly beneficial to the public. The situation at present is in a transitional stage. We may be on the verge of a period of rapidly accelerated development in the material well being of the country as a whole.

Within the last few years the public mind has become awakened to a new realization of its duties to itself and posterity in guarding and using wisely its birthright contained in the natural resources of the country. It is holding the corporations which it has created to serve it to a higher standard of efficiency and to a more strict accountability for their stewardship. National, state and city governments are alike becoming more effective and more responsive to the demand of the times. The people must study carefully and select wisely the policies which are to govern its management of its public utilities.

ELECTRICAL APPLIANCES AT HONGKONG.

Increased and increasing calls for electric appliances, especially for lighting apparatus, fans, and various special lamps, are reported by Hongkong importers. General progress is responsible for much of the demand, but the fact that Chinese merchants have found well-placed electric lights more effective and more economical than the light heretofore used in their places of business is also responsible for the present increase.

The demand for current has been such as to tax the capacity of local plants, while the extensive use of electric light has so directly affected the gas company that a little over two years ago it reduced the price of gas from $3.25 to $2.75 local currency per thousand feet (from $1.46 gold to $1.32 gold at exchange current at that date), and a reduction to $2.60 local currency has been made in the past six months. Further reductions are promised upon the completion of a new installation now being erected.

There is also a strong demand for electric light installations ranging from 60 lights up to 30,000 lights, including complete engine and power equipment, dynamos, switchboards, and wires and cables. The power desired is almost exclusively kerosene, crude oil, or suction gas motors of few and simple parts, which can be run by native engineers. A contract has just been let for a considerable plant at Fatshan, a suburb of Canton, which has been secured by an English branch of a concern generally considered American. A small plant for Kongmun is being competed for. The demand for these small plants is growing to such an extent that various American and other foreign concerns are reorganizing their South China agencies with a view to handling more business.

The demand for electric equipment generally includes all kinds of lamps, lamp stands and shades, particularly the new varieties of metal filament lamps; various grades of insulated wires and cables; insulating blocks; and nearly all modern electric novelties.

The demand for electric fans of all kinds is greatly on the increase. The demands for fans in Hongkong is largely for ceiling fans of wide radius and several speeds. The Hongkong power service is an alternating, 100-volt, current of 72 cycles per second. However, there has developed a considerable demand for desk fans for use aboard ship, and as a rule direct current is supplied for these. The current in Kowloon and various other points about Hongkong is direct.

THE CONCESSIONS SECTION OF THE PANAMA-PACIFIC EXPOSITION.

The concessions district at the Panama-Pacific International Exposition, corresponding to the wonderful "Midway" in Chicago, will be one of the most marvelous and attractive sections of the exposition. Many of the amusements will be presented for the first time and will be notable not only for their great size and artistic excellence but also because they are selected with a view to their educational value.

The number of applications for concessions is said to be totally unprecedented in the history of expositions. So far more than 6000 applications for concessions have been received and seventy-five applications, involving an expenditure of $6,800,000 have been accepted. More than 7000 people, it is estimated, will be employed in the concessions district and between $10,000,000 and $12,000,000 will be spent in installation in the concessions division when the exposition is under way.

The whole concessions district will be three thousand feet in length and will run through the center of the concessions district, sixty-five acres in area. Half way along the length of the thoroughfare will lie the superb "Plaza of Wonders," an area 250 x 300 ft. Surrounding the plaza will be buildings of impressive Roman architecture, in which will be housed many amusement novelties. Here also will be located a great band stand, the sub-offices of the Division of Concessions, and a fire station where methods of preserving life will be illustrated. In the decorative scheme around the plaza will be 140,000 lights, rendering it the glory spot of the night life of the Exposition. In the center of the plaza will be the highest flag pole in the world, a giant flag staff donated by the City of Astoria, 246 ft. high and over 5 ft. in diameter at its base.

ELECTRICAL PUMPING AND IRRIGATION

ROAD CROSSINGS AND DISTRIBUTING CANALS.

BY B. A. ETCHEVERRY.

Road crossings are necessary at all intersections of the canals with the highways and railways. As there are always many of these on every canal these structures are frequently more numerous than any other type. The crossing is usually made by passing the road over the canal by means of a bridge or culvert. For large canals a bridge is frequently used; for smaller canals a culvert is often more economical.

Bridges are usually short and may be made of wood, steel or concrete. The bridge may be made in a single span or intermediate piers may be placed in the canal. The bridge abutments must be connected to the canal with upstream and downstream wings extending well into the banks. When the canal cross section is contracted the bed of the canal must be protected with riprap to prevent erosion caused by the increased velocity. For short spans the bridge may be made of a single floor slab or a floor slab supported on girders. For larger spans regular trusses or arches are used.

Culverts.

Culverts are of two types, depending on the relative elevation of the drainage channel bed and the canal bed. The first type is used when the drainage channel is sufficiently lower than the roadway to permit the construction of the culvert conduit without depressing the floor of the conduit much lower, if any, than the bed of the drainage channel. The culvert consists of the conduit, the upstream and downstream wing extending well into the banks, the floor between the wings, which is made of concrete, wood or riprap and connects the floor of the canal to the floor of the culvert. The second type is used when the drainage channel is nearly at the same elevation as the roadway and it is necessary to lower the floor of the conduit below the bed of the channel sufficiently to construct the conduit under the roadway. The culvert is then a short inverted siphon and consists of the inlet and outlet well with the connecting conduit. The conduit may be either one or more lines of pipe, a concrete arch or a rectangular box culvert in one or more compartments.

The pipe culvert must be designed to resist external pressure. If the earth pressure is assumed as acting vertically it tends to collapse the pipe by shortening the vertical diameter and lengthening the horizontal diameter. This effect produces equal amounts at the top, bottom and sides (positive at top and bottom and negative at the sides).

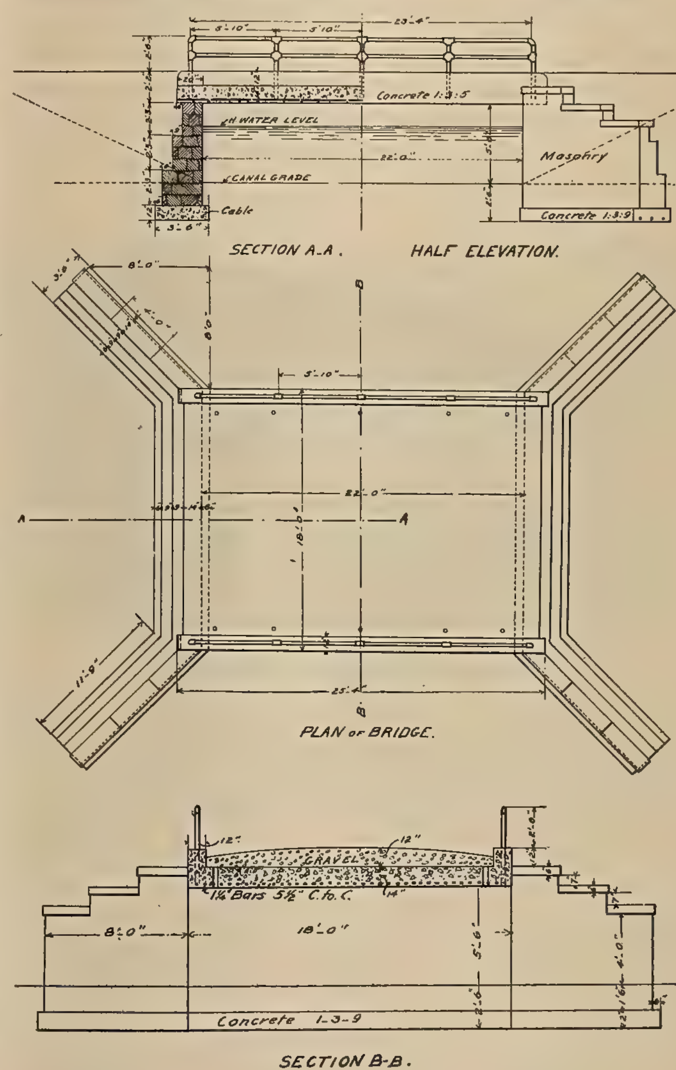
Let d = diameter of pipe in ft.

h = depth of fill in ft.

w = weight of fill per cu. ft.

The bending moment equation generally used is $M = 1/16\ whd^2$.

The rectangular box conduit may consist of one or more compartments, depending on the volume of water and on the height available between the floor of the drainage channel and the floor of the irrigation canal. The top or roof of the culvert is designed as a slab for a vertical pressure equal to the weight of earth filling above it. The floor has the same bending moment as the roof. The sides are designed for a horizontal pressure equal to 1/3 the vertical load.



BILL OF MATERIAL

Concrete	32 cu. yds	
Masonry	60 perches	
Coping	56 sq ft	
Corrugated Bars	36-1¼x24'	
Cable	670 feet	
Pipe	136	2" dia
Tees	10	2"
Crosses	6	2"
Elbows	4	2"

Reinforced Concrete Bridge Across Lamar Canal —American Beet Sugar Co., Colorado.

The cross sectional area is obtained by the short tube formula $Q = CA\sqrt{2gh}$ where h is the height of the water surface at the inlet above the water surface at outlet, C the coefficient of discharge for right corner depends on the length of conduit.

For conduit.	5 x diam.	10 x diam.	25 x diam.	50 x diam.
C =	0.79	0.77	0.71	0.64

With wings flush with the sides of the conduit and placed on an angle of 30 degrees the coefficient may be taken as about .90.

Examples of road crossings are given below. The United States Reclamation Service has issued standard designs with tables of pipe culverts and box culverts.

The county road bridge, American Beet Sugar Company, Colorado, crosses the Lamar canal. It has a span of 22 ft. and a width of 18 ft. The abutments and wings are of masonry. The bridge slab is 14 in. thick and made of concrete reinforced with thirty-six 1¼ in. bars, 24 ft. long and spaced 5½ in. center to center. On each side a coping which carries a pipe rail projects 12 in. above the floor of the bridge. The concrete used was mixed in the proportion of 1 part cement to 3 of sand and 5 of gravel.

Culvert Railroad Crossing With Warped Wings for Inlet and Outlet, Umatilla Project—Oregon.

Many of the crossings of the Santa Fe Railway with the laterals of the district are made by means of inverted siphons. These siphons consist of concrete inlet and outlet chambers spaced about 18 ft. apart and connected with cast iron pipes. The size and number of pipes vary with the size of the lateral, usually from 1 to 5 pipes, 24 to 36 in. in diameter are used. The pipes are placed horizontally and the outlet chamber is 6 in. lower than the inlet chamber. With this head a 24 in. pipe gives about 80 second ft. The bill of material given is for five 24 in. pipes.

In southern California cement pipe is extensively used for road crossings especially for the small ditches. The crossings usually consists of inlet and outlet chambers each made of one or two joints of large size cement pipe placed on end vertically, and connected at the bottom through a smaller size cement pipe laid across the road. The water is carried to the inlet through a cement flume which is connected to the top of the inlet pipe. To prevent the entrance of large bodies a screen is placed at the entrance. As the ordinary cement pipe will not stand great weight, if the road is used for heavy traffic the pipe should be very carefully backfilled. The strength of the pipe will be very much increased by forming a concrete bed around the lower half of the pipe. For large size pipes reinforced concrete is much more desirable.

Distribution System.

The distribution system consists of main laterals, sub-main laterals and individual distributaries or laterals whose purpose is to deliver the water at each farm. The main canal commands all the land to be irrigated which extends generally from the main canal down to the main drainage channel. This area seldom has a uniform slope but is divided into basins separated by ridges. For each basin there is usually a drainage line. The main canal, which is located along the higher boundary of the irrigated land, intersects these ridges. The intersections with the ridges are the heads of the main laterals. The main laterals are located as nearly as possible on the line of these ridges and each one commands the land on both sides extending from the watershed or ridge line down to the drainage line of each basin. Every main lateral is the source of supply for sub-main laterals commanding subdivisions of the area commanded by the main lateral. The sub-main laterals are the source of supply for the smaller laterals or distributaries whose object is to carry the water to each farm. Usually no water is taken out directly from the main canal or main laterals by the farm ditches or distributaries. It is always desirable to use as many main laterals as possible and to decrease to a minimum the total length of small distributaries because of the greater percentage conveyance loss in small canals.

In the lowest part of the basins and sub-basins forming the total area irrigated, are the drainage lines. These drainage lines may be well indicated by natural channels or creeks or may be the lowest thread of very gradual and flat depressions. These drainage lines are usually the place where the excess water collects and if not obstructed is carried to the main drainage channel or stream. On all systems except some pipe systems the main canal and distributaries cannot be operated with sufficient accuracy to prevent surplus or unused water at their lower end. If these lower ends are on private property the discharge of the surplus water at these points would cause not only local damage but may cause general waterlogging of the land below. For these reasons all canals should be terminated at a drainage or waste channel. Where the land is not provided with natural drainage channels it is usually necessary, except where water is used very economically and with great care, to provide artificial channels or improve existing channels. When the drainage channels are not sufficient to prevent the rise of alkali and the waterlogging caused by excessive irrigation, it is necessary to construct a complete drainage system. To remove alkali usually requires a system of underdrains for the lands so affected. Many irrigation systems should have a complete drainage system. It has been estimated by the Bureau of Soils that 13 per cent of all irrigated land had been rendered worthless or damaged because of the rise of alkali.

The main laterals and sub-main laterals usually follow the ridges as stated above and should be continued so that they will end at some drainage channel. The small laterals or distributaries will, if possible, be made to conform with the property lines and road lines. Because of the steep slopes sometimes obtained on the ridge it is necessary to use many drops.

The principals of design of the canal cross sections are the same as those given for the cross sections of main canals. The water level of the smaller

distributaries must be kept sufficiently above the surface of the ground to permit the installation of measuring boxes and the irrigation of adjacent land. This is very necessary in a flat country. The main canals and main laterals must be so designed and located that the water level will be kept sufficienty high to permit the diversion into the branches without the use of checkgates to hold back the water and raise the water surface. It is desirable to carry the water surface in the distributary even when partly full, at sufficient elevation above the highest point of land to allow for the loss in velocity head through the take out box and for the installation of a measuring box. Ordinarily a minimum of 6 in. and preferably 12 in. difference in elevation between the water surface in the supply lateral when running at ½ full capacity and the highest point of land to be irrigated must be provided. The checking of the water is not desirable because it increases seepage loss, encourages deposits of silt and may cause the overflowing of the banks and resulting breaks. However, they are frequently unavoidable. The grades and cross section must be adjusted to obtain, if possible, a gradually increasing velocity.

Continuous and Rotation Flow.

In a large system the main canal, main laterals and often the sub-main laterals are operated continuously, each receiving its proportionate share of water. The smaller laterals or distributaries may also be operated continuously but it is usually preferable to operate them intermittently according to a system or schedule of rotation which allows instead of a small continuous flow during the entire irrigation season, a greater volume for only part of the time or periods occurring at regular intervals. The advantages of the rotation system are:

1. The proportionate loss of water is less than by the continuous method because of the smaller percentage conveyance loss obtained with large volumes as compared to smaller volumes.

2. The larger head is very desirable and in some cases absolutely necessary to give to the irrigator a flow which can be handled. For instance a duty of 1 miners' inch to 5 acres may be ample, but if the orchard is only 10 acres and rotation is not practiced, then the orchard is entitled to a continuous flow of 2 miners' inches. With a stream of this size it would be hardly feasible to irrigate it. But if the irrigator is allowed 40 miners' inches for 1/20 of the time or 1½ days each month, he will receive the same amount of water and will be able to apply it in a very short time.

The disadvantages of the rotation system are.

1. It requires larger canals.

2. When the rotation periods are too frequent the loss due to the canal being alternately wet and dry may be greater than the saving due to the smaller percentage loss in conveyance.

3. The system of rotation requires the distribution according to a rotation schedule which increases the labor of operation.

The system of rotation is generally applied only to the smaller distributaries or to groups of distributaries, but may be applied to the sub-main laterals or even main laterals, on large systems during periods of low flow. The operation then becomes very complicated. A simple illustration is the following. If a main lateral supplies two sub-mains each irrigating about the same area, the entire flow may be allowed in each sub-main lateral in turn for one-half the time. Then the flow in each lateral may be subdivided in turn into groups of smaller distributaries.

Carrying Capacity.

In planning the carrying capacity of the canals of an irrigation system the duty must be known. The duty will usually vary considerably during the irrigation season. The demands are greater in the summer months than at the beginning or at the close of the irrigation season. When the stream flow is sufficient to meet this maximum demand the system should be designed for this maximum demand. On the other hand when the stream flow is insufficient to supply the water at this time of maximum demand, but is ample at the beginning of the season, then it will be desirable to use the largest volume at the beginning of the season and plan the system for this duty. The carrying capacity of the main canal and main laterals are based on a continuous but not uniform flow depending on the duty of water determined for the period of maximum demand or maximum available supply and on the area irrigated, making all necessary allowances for conveyance losses and for the acreage of the land under the system which will not be irrigated, such as land occupied by roadways and buildings and land which is dry farmed or not farmed at all. The relative amount of water used during the irrigation season for different sections of the arid region is illustrated by the following examples:

Relative Amount of Water Used During Irrigation Season Expressed in Per Cent of Entire Amount.

	Riverside Water Co., California, 1901-1908.	Rocky Mountain States: Colo., Wyo., Utah, Idaho.	Snu River Project, Montana.	Lower Yellowstone Project, Montana, 1909.	Lower Yellowstone Project, Montana, 1910.	Sunnyside Canal, Washington, 1909.
Jan. ..	5.3					
Feb...	2.0					
Mar....	3.4					
April..	7.8		1	2		8.5*
May ..	12.8	10	9	2	8	20.
June .	12.0	30	30	21	22	20.
July .	12.0	30	22	31	32	21.
Aug. ..	11.8	20	30	22	13	22.
Sept ..	10.6	10	8	18	22	9.5**
	8.3			6	3	
	7.0					
	7.0					

*April 15-April 30. **Sept. 1-Sept. 15.

The carrying capacity of the main canal should be decreased at the intersections with the main laterals according to the amounts taken out. This will also apply to the main laterals if rotation is not practiced between sub-main laterals. The carrying capacity of the sub-main laterals, when rotation is not practiced between them, is based also on continuous flow, but in case of rotation the carrying capacity will be based on the duty and the frequency of the periods. When the smaller laterals or distributaries supply only one or a few farms, it must have a carrying capacity of at least one irrigating head, and the time for which this head is supplied in turn to each farm depends on the size of the head as compared to the continuous flow allowance. When the distributary supplies a number of farms the carrying capacity may be figured on a continuous flow and the volume divided into a number of irrigating heads supplied in rotation to groups of farms.

PROBLEMS IN THE REGULATION OF PUBLIC SERVICE UTILITIES.

BY G. A. LEE.

For some time, in Washington and other states, common carriers, including primarily steam and electric railroads and telephone and telegraph companies, have been subjected to rigid state and federal regulation and supervision. Only in recent years, and only within the last two years in Washington, has the police power of the state been extended to include and regulate other public service utilities, such as water, gas, electric light, power, and irrigation companies. We have today in this state a comprehensive and scientifically drawn public service commission law.

Public service commissions, if composed of fearless, intelligent, reasonable, and fairminded men, are a great benefit, in my judgment, not only to the various communities, but also to the various utilities regulated. The commissions act in many instances as arbitrators between the public on the one hand and the utilities on the other, and by intelligent, sane and conservative action and treatment, settle innumerable disputes, some of a petty, and some of a grave nature, thus avoiding friction and litigation, and establishing and directly creating a better relationship between the public service company involved and its patrons.

Another benefit flowing from regulation of this character is the fact that frequently a patron or consumer of the company is unwilling to believe that there is a company's side to the controversy. By intervention and investigation the public service commission frequently finds that the attitude of the company is correct and should be sustained, advising the complainant accordingly. The complainant, having had the opportunity of appeal to an impartial and unbiased state tribunal, is satisfied, the dispute is closed, the controversy ended, and a better feeling established. This is very frequently done by commissions in what would seem to be small and minor matters, but as you all know, the disposition of these minor questions means the establishment of the good will of the patrons or consumers, and such good will is a valuable asset. Many concrete instances might be cited, in which the Washington commission for instance, has acted promptly and efficiently, as above suggested, with gratifying results, but I think that the mere statement of the general proposition speaks for itself.

Again, and perhaps the most important benefit arising from state regulation is the fact that public service utilities are gradually but certainly being removed from the sphere of local politics. Heretofore, public service companies have frequently been compelled to be the "football," so to speak, of municipal politics. It must be apparent, and is apparent to all fair-minded students of the problem, that so long as local prejudice, jealousies, and influences control in the local regulation of public service utilities, such regulation can never become effective or wholesome.

A third, and fundamentally important benefit arising from commission laws is the fact that public service regulation is the only reasonable alternative of public control and ownership. Such regulation affords and secures all of the benefits and advantages incident thereto. If such regulatory laws secure to the people good service, reasonable rates, and safe and efficient instrumentalities and facilities, then certainly there can be no logical or convincing argument in behalf of the surrender of such regulations for the experimental and dangerous plan and principle of municipal or state ownership.

In my judgment, the passage of public service commission laws in many states in the last few years marks a new regime, and gives to the public that service and those rates to which they are entitled, and gives to the companies that protection and that rate of return which the constitution and fundamental laws of the land permit, and at the same time avoids the dangers and pitfalls of municipal regulation and municipal ownership.

Hastening, and coming now to a brief discussion of the dangers of public service regulation, we come to a field that is extremely important. It may be admitted, and in view of the foregoing facts and data, will be admitted that efficient, capable, and honorable public service commissioners can and do render invaluable service to the state and to the companies. If, on the other hand, the members of the state commission lack courage and integrity, and attempt to prostitute their position and immense power for ulterior personal or political ambitions, then and in that event the entire superstructure of regulation falls and such regulation becomes a mere fiasco.

Politics have no place in public service commissions. The members of these commissions should be men of fine ability and integrity; of fearless and judicial temperament; otherwise the failure of the work will be just as great as municipal control has been in the past, and the fundamental vice of municipal control rests, of course, in the politics of the situation.

Another danger of public service regulation is the fact that many commissions are not able, or are unwilling, to take a broad, fair, and reasonable view of the problems confronting them. If, for instance, values of public service properties are placed low in order to satisfy popular clamor; if the law and the facts of the case are ignored; if unfair, unreasonable, and confiscatory rates are imposed and ordered, and if generally speaking the utilities are not accorded those rights, privileges, and protection to which the law and the constitution entitle them, then the dangers and pernicious results of such regulation outweigh all of the advantages and benefits outlined above.

Recently, in Washington, D. C., in conversation with the chairman of a certain public service commission of one of the Mississippi Valley states, he stated to me that in no event should capital invested in public service properties be entitled to a greater net return than two per cent. The only argument which he presented in favor of such a statement was that capital, both active and inactive, in the United States averaged no greater rate. This commissioner either overlooked or ignored the speculations, hazards, and dangers incident to many investments in public service properties. He apparently forgot that capital is frequently sunk in these enterprises for many years before any returns are received. He forgot that many of these great industries are constructed years in ad-

[The following article is abstracted from an address before the Stone & Webster Club at Seattle, Wash.—Ed.]

vance of the time and that large cities are frequently made possible by the foresight, judgment and wisdom of investors in public service properties. In all other industries these facts and factors are rewarded; why not in the public service business? I answered him by saying that the courts, both state and federal and the most eminent commissions of the United States had almost universally held that any net return under six per cent was unreasonable, confiscatory, and unconstitutional. His only reply was that the courts and commissions were wrong. I cite this conversation to show what I mean by one of the very grave dangers of public service regulation.

In touching upon the last and final thought, as to how regulation can be made more effective, I simply wish to challenge your attention to the fact that you are not only employes of your particular companies, but are citizens of the state. As such citizens and as such employes you are charged with the important duty of obeying the statutes and laws of the state. If you conscientiously perform that duty, and discharge the obligations and duties imposed upon you by the public service commission law there is no question but what regulation can be made more effective. Good service on the part of public service companies can only come from efficiency, loyalty, industry, and integrity on the part of its employes. A public service company can be no stronger than the character of the men who constitute it. Such qualities and practices not only spell good service, but in the final analysis mean that fewer complaints are registered against the company, either with the company or with the commission. The people generally require and are entitled to good service; whether or not that service will be furnished rests in your power.

The question of rates is generally a secondary and inferior one, and it is therefore essential that each employe should direct his best energy and ability toward good service. If so the relationship between the company and the public will be a pleasant one and the relationship between the company and the public service commission agreeable and harmonious. The attitude of the average employe with whom the public comes in contact frequently determines the judgment and attitude of the public toward the company which the employe represents. This is fundamental and needs only to be stated to emphasize its importance.

A somewhat extended experience on the public service commission of Washington convinced me that the utilities of the State are meeting the regulatory legislation of the state in a fair and honest manner. They fully realize that their business is impressed with a public use and that the consuming public is entitled to certain legal rights. On the other hand, experience has shown that the average citizen is reasonable, and that if relief is denied by the commission the complainant is generally satisfied. The greatest enemy of public service regulation today is the unfair and unscrupulous municipal agitator, desiring political or other preferment, and appealing to the sympathies and prejudices of the people. The people cannot always be misled, however, and are rapidly coming to recognize and appreciate that there are two sides to the controversy, and that equity and fair treatment must be accorded the utility if the community is to progress and prosper.

As the supreme court of the United States in the case of Knoxville vs. Knoxville Water Company, 212 U. S. 18, remarks:

"The regulation of public service corporations, which perform their duties under conditions of necessary monopoly, will occur with greater and greater frequency as time goes on. It is a delicate and dangerous function, and ought to be exercised with a keen sense of justice on the part of the regulating body, met by a frank disclosure on the part of the company to be regulated. The courts ought not to bear the whole burden of the saving of property from confiscation, though they will not be found wanting where the proof is clear. The legislative and subordinate bodies, to whom the legislative power has been delegated, ought to do their part. Our social system rests largely upon the sanctity of private property and that state or community which seeks to invade it will soon discover the error in the disaster which follows. The slight gain to the consumer which he would obtain from a reduction in the rates charged by public service corporations, is as nothing compared with his share in the ruin which would be brought about by denying to private property its just reward, thus unsettling values and destroying confidence. On the other hand, the companies to be regulated will find it to their lasting interest to furnish freely the information upon which a just regulation can be based."

The regulation of public service corporations is a delicate and dangerous function, and ought to be exercised with fairness and justice. I have an abiding faith in the sound judgment of our Western people. Their spirit of fairness is always dominant. The great issues above suggested can never be settled until they are settled right. On the one hand let us demand of the public service companies that they serve the public fairly—efficiently; that their rates be reasonable, consistent with their investment and hazards; that they faithfully discharge their trust as public agents and almoners of public necessities. On the other hand, let us insist that fair and honorable treatment be accorded these utilities. Let us do all we can to remove them from the sphere of petty politics and local jealousies. Let us educate our people to the fact, so well expressed by the Supreme Court of the United States, that our social system rests largely upon the sanctity of private property and that utilities, as well as all others, are entitled to a fair compensation for their service, their risks, their investments.

Let us meet and solve these fundamental problems in a calm, judicial, and dispassionate manner. Let us all, regardless of political creed or business connection, regardless of personal or sentimental considerations, earnestly seek the law and the facts. And finally, let us remember in our efforts to adjust and settle these grave economic, financial, industrial and social questions that equity and fair play should be accorded equally and without discrimination to all public service corporations, as well as to all citizens.

JOURNAL OF ELECTRICITY
POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advrtisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Transformer Oils

Transformer oil, its proper character, treatment and use, has been much neglected by central station engineers. It forms one of the weak links in the chain of a high-tension electric-transmission system. In its dual function as insulator and cooler it requires high dielectric strength and high flash point, combined with great fluidity. It should be neutral so as to not dissolve the insulation of the core and coils immersed in it.

Of these qualities, the dielectric strength is the most variable, for it depends largely upon the amount of moisture present. The popular axiom that oil and water do not mix is not scientifically correct, for oil does absorb a small amount of moisture that materially lessens its dielectric strength. We know of an oil that broke down under 16,000 volts when wet, but stood the test of 40,000 volts after being dried. While oil and water do not chemically mix, they may mingle so closely as to require steam or rheostat heating to remove the water. Every precaution should be taken to keep oil dry during shipment and in use, for it abhors dehydration even more than "Nature abhors a vacuum."

It should have a high fire or flash test to eliminate danger of fire. Crude oil is refined by fractional distillation, the most volatile products passing off first. These are low in gravity and in burning temperature, as is exemplified by gasoline. Kerosene for use in lamps is one of the next products, soon followed by an oil suitable for transformer purposes. This usually has a gravity of 30 degrees, Baume, or less, and burns at about 300 degrees, Fahrenheit. The higher the temperature at which the product is distilled, the greater its viscosity. Consequently what is gained in flashing temperature is lost in fluidity. Acid introduced into the refining must be removed by adding just enough alkali to render the oil neutral. Many other valuable products of oil refining have been and are yet to be found, but "they are another story."

These conditions, briefly outlined, have been met by various companies supplying transformer oils. On the Pacific Coast, Eastern "Mineral Seal" was first used. Later, Western "Mineral Seal" was introduced, it having an asphaltum instead of a paraffine base. Subsequently, "Transil No. 6" and many other oils, whose names are legion, have been offered for sale, much as each druggist sells his own brand of hair restorer. Nearly all these are originally bought from the same company, mayhap the same tank, and have been specially treated to impart the desired qualities. The trade name is a distinction without much difference in quality. Disastrous fires, occurring when the oil has been volatilized by an arc, are credited to one and all of them. Another frequent trouble is the deposition of a thick, carbonaceous, jelly-like sludge on the cooling coils and in the circulating ducts. The former are covered so thick that cooling is not effected, and the latter are so clogged that circulation is difficult. Such deterioration generally occurs when the oil has been overheated. The deposit is easily washed off when hot, but becomes hard and brittle upon exposure to the air, resembling bitumen in this respect. The deposits around the points of high potential allow

creepage, so that a medium of high resistance may become a conductor.

But careful examinations of these troubles show that they are usually due to no inherent fault of the oil, but to the transformer design, or more particularly to the attendant's carelessness. We have instances of transformers that have been in continuous service for twelve years without any change being made in the oil. As a consequence, is it to be wondered that the transformer runs hot? Its design is condemned by the man who has grossly neglected it. He futilely attempts to remove the difficulty by changing to another oil, temporarily solving the question until this oil, too, becomes unfit for service, and the same trouble again occurs. Careful break-down tests should be made not only when the oil is furnished, but at frequent intervals thereafter, once a month not being too often for main stations. Tests for acidity will avoid the destruction of the insulation by dissolving, and flash tests will often prevent fires. The carbon may be removed by occasional filtering. In case of leaky cooling coils, the water should be drawn off from the bottom until such time as the transformer can be taken out of service and properly repaired.

All this trouble occurs with both water and self-cooling transformers. Where water is plentiful, it has been suggested that outside circulation of the oil would cause better cooling, and larger ventilating ducts would not become clogged. We attain success only by the most careful attention to the details of our work. Look after the oil, and transformer troubles will take care of themselves.

The Romance of Engineering

It is a matter of current comment that the life of an engineer is an unromantic one; that the deadly monotony of his work tends to blunt his finer sensibilities. While we must admit that it is not a particularly exhilarating task to hold the speed indicator on an engine or to watch a weir, and that it is not conducive to the development of the imaginative faculty "to determine the maximum number of blisters that can be placed upon the thumb by the ring end of a steel tape," yet the same may be said of almost any other kind of work that fits for higher things. It is only through the apprenticeship of drudgery that the master workman is developed.

The main essential is not to become a mere time-server while learning the necessary rudiments, but rather keep the mind receptive to new ideas, and observe the possibilities for improving old methods. In this age of action and energy there seems to be a tendency to neglect that old-fashioned virtue of occasionally thinking of something beside the humdrum of work. The engineer that allows his work to run him, who goes to his home so preoccupied with his difficulties as to neglect his family ties, is not living, but merely existing.

There is, perhaps, no better way of illustrating our meaning than by referring the reader to some of the writings of Kipling wherein he deals with the romance of the commonplace. He shows us the romance of everyday life, of commerce and of machinery. Refuting the idea that every new invention or discovery tolls the knell of romance, he tells of the pleasures of the locomotive and marine engineer who can lighten his work with an appreciation of the beauty, wonder and love for life, "though there arn't a wave for miles and miles excep' the jiggle from the screw," yet the fascination of seeing the world keeps him satisfied with his work.

The great trouble with most of us is we do not see beyond the end of our monkey-wrench. It is not necessary to become idle dreamers, but a little exercise of our imagination, an occasional study of the ideal, will raise us from the rut of the commonplace and remove that stigma of being unromantic.

Utilization of Atmospheric Nitrogen

The tiller of the soil may be likened to the owner of the magical wild ass' skin in Balzac's story of the "Peau de Chagrin." While the possession of this skin gave the means of satisfying every wish, yet its size represented the duration of the owner's life, and for every desire gratified the skin shrank accordingly, until finally both life and hide vanished with the gratification of the last wish. Similarly nitrogen and other foods required for the growth of plants are withdrawn from the soil by each successive crop, until at last the land becomes exhausted—the electrolyte in the storage batteries which furnish the power used by man is low. It has been found, however, that by adding nitrogenous compounds to the soil its fertility may be restored. But so rapidly—more rapidly than they are being replenished—have the natural manures been depleted by an ever-increasing demand, that all available guano and sodium nitrate deposits will ultimately be exhausted. The sorry plight of the Ancient Mariner, "water, water everywhere, nor any drop to drink," until recently bid fair to be that of the farmer, living in a sea of nitrogen but unable to use it for his most pressing need, that of fertilizing a wasted earth. Neither plants nor animals can exist without nitrogen, and yet they cannot assimilate it from the air they breathe.

It seems strange that elementary nitrogen is so inert, and yet its compounds are so singularly active; inert as a diluent of the air, active in explosives and in the poisonous alkaloids, such as morphine and strychnine. Because of this marked inertness, possibly due to the strength of the atomic bonds within the molecule, and because of the indirect processes by which its compounds are formed, as well as their usual instability, the fixation of atmospheric nitrogen has been a difficult task.

Nitrogen is one of the most abundant, and at the same time one of the most expensive elements. There are nearly twenty million tons of nitrogen in the air over every square mile of the surface of this earth, or over seventy million times as much as is contained in the 1,740,000 tons of saltpetre exported from Chili in 1907. Though it exists in such enormous quantities, heretofore it has been directly used by only a few plants which were able to absorb the nitrogen from the air diffused through the soil. Here it is that the puny strength of the tiny microbe is almost as powerful as the mighty force of electricity, which is now being used to supply thousands of tons of commercial fertilizers.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

D. S. Ewart, electrical contractor of Astoria, Oregon, visited in Seattle last week.

Ralph Krows, proprietor of the Ralph Krows Electric Company, Seattle, is spending a week east of the mountains on business.

E. M. Cutting of the Edison Storage Battery Company, San Francisco, is making an extended trip through Southern California, Arizona and New Mexico.

H. B. Squires of the firm of H. B. Squires & Company, San Francisco, returned home the first part of the week after an extended trip to Chicago and the east.

C. F. Adams, having completed the Kaweah No. 3 power plant in the Sequoia National Park, for the Mt. Whitney Power Company, has returned to San Francisco.

T. W. Peters, formerly with the operating division of the Seattle light department has joined the force of the General Electric Company at Schenectady, New York.

W. L. Goodwin, manager of the Pacific States Electric Company, left the beginning of the week for a couple of weeks' vacation in the woods of northern Marin county.

W. F. Nieman, sales manager of the Great Western Power Company, is again at his desk after a few weeks' auto-vacation trip through Lake and the north of bay counties.

E. S. Code of the detail and supply divisions, Seattle office Westinghouse Electric & Manufacturing Company was recently married to Miss Elizabeth Merilees of Vancouver, B. C.

W. Guthfahr, electrical engineer, formerly of Sonora and Chihuahua, Mexico, is in San Francisco and is supervising the electrical installation at the Avon plant of the Associated Oil Company.

A. E. Barlow, coast sales manager of the American Ever Ready Company, with headquarters at San Francisco, paid a business visit trip to Seattle, Spokane and other northwest points recently.

W. Brewster Hall, representing Pass & Seymour, at San Francisco, who underwent an operation for appendicitis on the 10th of this month, is again at his desk and performing regular office routine.

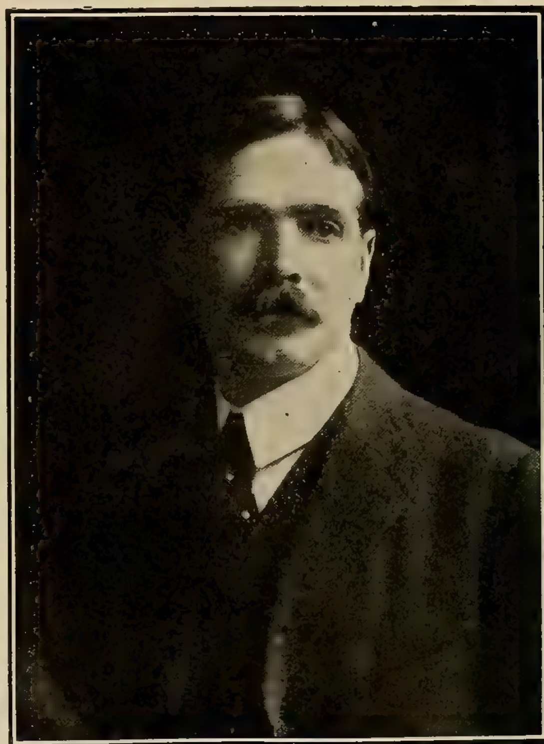
John C. Bird, formerly with the Kendrick Electric Company, Tacoma, has been made manager of the Westinghouse Lamp Company's Seattle office, succeeding **R. H. DeMott**, who has gone to the Chicago office of the company.

Wm. E. Roos, representing the Western Wood Preserving Company, Los Angeles, has established headquarters at room 501, Rialto Building, and is devoting his time to the care of the company's interests in the northern part of the State.

H. J. Gille, who resigned from the position of general manager of the St. Paul Gas & Electric Company at St. Paul, has arrived in Seattle and accepted the position of sales manager for the Puget Sound Traction, Light & Power Company.

Alexander G. McAdie has accepted the chair of Professor of Meteorology and director of the Blue Hill observatory at Harvard University, and will assume the duties of his new position in the fall. He will succeed the late Professor A. L. Rotch, who founded the observatory and who has done pioneer work in exploring the air.

Professor McAdie was born in New York in 1863. He was graduated from the college of the City of New York in 1881, receiving his A. M. degree from there in 1884 and the same degree from Harvard a year later. His service with the United States began in the Signal Office in 1886. He was for four years connected with the Weather Bureau at Washington and later went to New Orleans as local forecast official. He came to California in 1899 as local forecast official and was for a while connected with the University of California as honorary lecturer. He has held his present position as forecaster in San Francisco for eighteen years and in that time has won a host of friends.



Courtesy of Town Talk Publishing Co. Alexander G. McAdie

During his long career he has written many scientific publications. "Clouds and Fogs of San Francisco," written about two years ago, is his best known book. He is an associate editor of the National Geographical Magazine, a member of Washington Academy of Sciences, and president of the Astronomical Society of the Pacific.

Professor McAdie has written a number of articles for the Journal of Electricity on Water Supply, a subject of greatest importance to the engineer. He was also for a number of years one of the executive officers and a director of this journal.

He will be missed by his many California friends, who wish him success in his new connections.

NEW PRESIDENT OF THE GENERAL ELECTRIC COMPANY.

Mr. C. A. Coffin has resigned as president of the General Electric Company and Mr. E. W. Rice, vice-president of the company, has been elected as his successor. Following his resignation as president of the company, Mr. Coffin was elected chairman of the board of directors. Mr. Coffin has served as president of the company since its organization as the General Electric Company and his successful career in that position is aptly illustrated by the wonderful success of the company.

Mr. Rice has also been connected with the company since its organization and his ability to carry on the work of his predecessor is unquestionable.

OBITUARY.

Fred Neilson, the well-known electrical contractor of the firm of Neilson & Smtih of Santa Barbara, died Monday, June 23r, at his home after a long illness. Mr. Neilson was president of the Santa Barbara Local State Contractors' Association and during his connection with the contracting business made many friends who deeply regret his death. He is survived by a widow and one child.

MEETING NOTICES

Electrical League of Southern California.

At the regular meeting of the League held at the Angelus Hotel on June 24th, Mr. Paul Shoup, president Pacific Electric Railway, gave a talk on "Transportation." This will be the last meeting until September.

Electrical Development and Jovian League.

The final meeting before the vacation period July 1 to Sept. 1, was held last Tuesday. It being an entertainment meeting no special business was transacted. The speaker of the day, Mr. F. H. Brown, talked on electric sign wiring and display.

Los Angeles Jovian League.

At the rejuvenation held on June 19th at the Union League Club, 27 candidates were initiated. There were 62 Jovians present to enjoy the banquet and popular song choruses which were printed on the menu and sung by all. The rejuvenation was necessary due to the great enthusiasm shown at the last one held on May 19th.

Seattle Jovian League.

The Seattle Jovian League has found that it cannot procure the proper facilities for making a display during Potlatch week, and instead of the electrical float or pageant will give a special luncheon and entertainment Friday noon at the Rathskeller. A general invitation will be extended to all electrical men in the city to be present and all of those out of the city will be invited as guests of the Jovians.

Oregon Technical Club.

Mr. D. D. Clark, Chief Engineer for the Portland Water Board, gave a historical sketch of the water supply of the city of Portland, at the regular Monday luncheon of the Oregon Technical Club. Mr. Edwin A. Taylor, Superintendent of Construction, explained the physical properties and method of serving the growing population of the city. He also dwelt at length upon the development of the system, and described the new Mount Tabor reservoirs. Mr. E. A. Stanley was chairman of the day.

San Francisco Section, A. I. E. E.

The results of the May election were as follows: Mr. C. J. Wilson and Mr. A. H. Griswold were elected to the two-year term, and Mr. J. P. Jollyman to the one-year term, Mr. P. T. Hanscom and Mr. A. G. Jones being the holdover members of the executive committee.

It will be the endeavor of the executive committee to arrange a complete programme of papers to be presented during the season and place this programme in the hands of the members during the coming September. The secretary would be pleased to hear from any member who would like to make suggestions as to subjects which would be treated during the 1913-14 season. Such suggestions should reach the secretary before the end of July. The next meeting will be held the fourth Friday in September.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Mount Jackson Water and Power Company has appled for authority to issue $11,000 in bonds for the purpose of paying off certain indebtedness and of making improvements to its system. The Mount Jackson Water and Power Company operates in Rionido, Sonoma County.

The commission has rendered a decision granting authority to the Southern California Edison Company to pledge as collateral security for loans a portion of the $2,500,000 of bonds previously authorized by the commission.

The commission has granted authority to the Pacific Gas and Electric Company to issue $5,000,000 of its general and refunding mortgage bonds at 85 and $150,000 in promissory notes.

The Home Telephone and Telegraph Company has been granted a certificate of public convenience and necessity to exercise franchise rights in the city of South Pasadena, Los Angeles County.

TRADE NOTES.

The Wahlgren Electric Company, Everett, Wash., has secured the contract for the entire lighting and power installation in the Everett Ice Company manufacturing plant.

The North Coast Electric Company has purchased the business of the Kendrick Electric Company at 710-712 Wistun avenue, Seattle, and will continue business at that address.

A. W. Wilkinson & Sons, sawmill designers of Minneapolis, are preparing plans for the complete electrification of the Weyerhaeuser Timber Company sawmill at Everett, Washington.

The Pacific States Electric Company anounces the completion of sales arrangements with the American Cross Arm Company and will in future handle their product on the Pacific Coast.

The Sound Manufacturing Company, 810½ Railroad avenue, Seattle, has installed a large amount of machinery to be used in making special boxes for electrical appliances on short notice.

The Seattle city council has awarded a contract to Nettleton-Bruce-Eschbach Company, a local concern, for constructing the masonry power and water supply dam on Cedar river at $687,110.

The Ralph Krows Electric Company, Seattle, recently made extensive improvements in its place of business, putting in a new front, new signs, etc. A large amount of shelving and other fixtures will be installed in the near future.

Lewis, Wiley & Morse Inc., hydraulic contractors, Seattle, have a contract to make a 100,000 yard fill for the Northern Pacific Railway Company. This work is being done in connection with a contract under way for the city on Alki avenue.

The Pacific Electric Company of Everett, Washington, recently installed complete electrical equipment in the laundry building of the Cavanaugh Timber Company at Camano, Washington. This company has also completed the job of installing electrical equipment in the Princess Theater at Everett.

The Reynolds Electric Company, 310 First avenue south, Seattle, is putting in a 50 h.p. Westinghouse 2000 volt motor for the Hammond flouring mills. Motors are also being rearranged and the high tension work put in first class shape. The new installation is in addtion to the 600 h.p. already installed.

The Puget Sound Traction, Light & Power Company is supplying power for the operation of the new shingle mill of the Clough-Hartley Company of Everett, Washington, The mill will have a capacity of 500,000 shingles per day and will be electrically operated throughout. The General Electric Company furnished the complete equipment consisting of transformers and motors.

An innovation has been added to loose leaf net price book distributed by the Pacific States Electric Company showing all cuts available for advertising, which are furnished free to the trade. This innovation has proven particularly attractive to dealers and contractors throughout the country who have occasion to advertise electrical material and who have been handicapped in the past with their inability to secure these cuts on short notice.

NEWS NOTES

INCORPORTIONS.

DINUBA, CAL.—Alta District Gas Company, $45,000 by A. A. Weber, G. W. Wyllie, R. W. Wilson and W. L. Muncy.

LOS ANGELES, CAL.—Petroleum Gas Reduction Company; capital stock, $500,000; W. C. Cutler, W. P. Stevens, J. F. Vordermark, G. I. Leonard and R. O. Wrana, directors.

SEATTLE, WASH.—The North Coast Electric Company has been incorporated under the laws of Washington to deal in electrical applicanaces and supplies. The capital stock amounts to $60,000, all of which has been subscribed. Officers of the company are Harry Byrne, president and manager; E. R. Welles, New York, vice-president and treasurer and W. R. C. Cocke of Seattle, secretary.

ILLUMINATION.

KLAMATH FALLS, ORE.—First steps have been taken toward the municipal ownership of light and power for the city.

ALHAMBRA, CAL.—The lighted way within the limits of Alhambra is soon to add another five miles to the system already in operation.

ABERDEEN, WASH.—A petition for a municipal power and light plant has been presented to the council. The estimated cost is $900,000.

FULLERTON, CAL.—Residents of Placentia have petitioned for the formation of a lighting district, in order to provide street lights for this community.

OAKLAND, CAL.—The contract for street lighting for the coming fiscal year has been awarded to the Pacific Gas & Electric Company by the city council.

BUTTE, MONT.— A petition will be presented to the council for the extension of the luminous arc lighting system to practically all of the business district.

MONTESANO, WASH.—J. F. Hartsung and F. Norton Babo have organized a light and water company and will apply for a franchise in this city. They guarantee to furnish current for lights within 30 days.

TURLOCK, CAL.—The Yosemite Power Company has finished work upon the light and power line to the town of Denair, and is now ready to furnish both light and power to the residents of that part of Stanislaus county.

BREMERTON, WASH.—The city council of Bremerton, Washington, has passed a resolution calling for the purchase of the property belonging to the Bremerton-Charleston Light & Fuel Company with a view to making a municipal plant of same.

SAN FRANCISCO, CAL.—Two light rate ordinances formulated by the supervisors' light committee have been passed to print. They cover a 75c maximum charge for each 1000 cu. ft. of gas consumed and a 6c per kilowatt-hour electric lighting rate.

ALBANY, ORE.—A franchise for a gas plant in Albany has been granted C. L. Rauch of Portland. Rauch represents capitalists of Portland and Detroit, Mich. He must file a bond of $5000 to begin work before January 1, 1914, and have the plant in complete operation before December 31, 1914. The franchise runs for a period of 20 years, at which time the city has the option of buying the plant.

OAKLAND, CAL.—The board of trustees of Piedmont took the initial step at a recent meeting toward providing a municipal lighting system with underground wires. A report on the cost of the proposed system was submitted by City Engineer E. C. Prather, showing that an underground system covering 11½ miles of streets in Piedmont, with arc lights, will cost $44,000, with $20,000 for poles and wires. A tungsten system, covering the city could be installed for $51,000, with poles and wires costing $22,500.

TRANSMISSION.

PORTLAND, ORE.—Plans for a substation and transformer house for the Northwestern Electric Company in the Albina district have been completed.

EVERETT, WASH.—The Pacific Northwest Traction Company has applied for a franchise to construct underground conduits and pole lines for transmission of electric current for power, heat and lighting.

OLYMPIA, WASH.—Millard Lemon and Wilbur B. Foshay, their heirs and assigns have been granted the right to operate electric lines for transmitting electrical energy for heat and power for public use with all necessary poles and other appurtenances along the highways of Olympia.

REDLANDS, CAL.—The city trustees are taking steps towards the construction of a $6000 power line by the city from the city limits to the pump plants of the municipal water system, to carry out a contract with the Southern Sierras Power Company to furnish power for operation of pumps at the well.

LEWISTON, IDAHO.—The United States Land Office at Lewiston, Idaho, has received word from the department of the interior that 7,370 acres of land on the Snake and Salmon Rivers in the Nez Perce national forest have been withdrawn for power purposes. It is estimated that 350,000 h.p. can be produced at the sites found on this land.

STOCKTON, CAL.—The First Federal Trust Company of San Francisco has recorded here a $10,000,000 trust deed given by the Oro Electric Corporation to cover the Oro Company's bond issue in the same amount of 6 per cent 40-year bonds. The filing of the trust deed in this county was made necessary by the recent acquisition of property here by the electric company.

SEATTLE, WASH.—Frank McKeen, electrical engineer, Seattle, is installing a 500 h.p. hydroelectric unit for the Mason County Power Company in the Olympic Mountains in the Hoods Canal District. The current is to be used in smelting ore from the mine of the Manganese Products Company situated about 10 miles above Lake Cushman. This is the initial installation of what is to be a 120,000 h.p. plant.

SAN FRANCISCO, CAL.—Commissioner Thelen presided at the hearing of the Pacific Gas & Electric Company's application for leave to issue $5,000,000 of its general and refunding bonds. From the evidence of M. H. Bridges and D. H. Foote it appears that since March 15 the company's construction at Lake Spaulding and elsewhere has been defrayed out of the earnings, short-time loans, etc., the proceeds of the recent debenture issue having been consumed. The total of such expenditures to date aggregate $1,767,488.14, being apportioned as follows: March $365,564; April, $582,-000; May, $818,000. The balance of the proposed issue, $3,410,000 in bonds, is expected to cover the completion of the

South Yuba development, which includes the Lake Spaulding dam and reservoir. The Cordelia-San Rafael tower line is also to be taken care of out of these funds.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The Municipal Railway is now in operation from the ferry to the beach. The first car made the trip on Wednesday.

EVERETT, WASH.—The Everett Interurban, Everett, Washington, operated by the Northwest Traction Company, on account of increased business, has constructed an addition to its freight shed practically doubling its capacity.

SAN FRANCISCO, CAL.—The state board of harbor commissioners will furnish all the terminals for municipal, United Railroads, or any other corporation that will build a line of elevated roads to the fair grounds. If the city does not make some move the state will within 60 days go ahead with its plans to bridge Market street.

TULARE, CAL.—Signalizing the completion of the Big Four railroad grading over the first section of the work from Tulare to Woodville, a distance of seventeen miles, the directors of the road met here and let the contract for furnishing steel rails for the system. Grading crews have been moved from this city to Woodville, and work will be started forthwith on the completion of the line to Poplar. When steel is laid on this latter section construction will be pushed on to Porterville. It will be the purpose of the directors to start cars running as rapidly as the various blocks of the work are completed.

SAN FRANCISCO, CAL.—Rights of way to the Sacramento Valley Electric Roalroad with terminal properties at Solano City at the head of the new tidewater canal have been granted by the Solano Irrigated Farms Company. The new road will cross the Oakland, Antioch and Eastern, with which traffic arrangements have been made for direct shipments to bay cities. Construction of the first thirty-five miles of single track to Woodland will begin in three months. Permission for a six million dollar bond issue will be asked of the Railroad Commission, and of this $750,000 will be expended on the first unit of the line. Later the road will be extended up the Sacramento Valley to Red Bluff, a distance of 195 miles.

SAN FRANCISCO, CAL.—The public utilities committee of the supervisors has decided to recommend to the board that the term for the redemption of the municipal railway bonds be fixed at 35 years, the intention being to annually pay off $100,000 of the proposed bonded indebtedness of $3,500,000. Redemption will not begin until five years after the date of the bonds, so that 40 years from the time of issue will elapse before the last of the bonds is redeemed. The committee has concluded to omit the provision giving the city the right to redeem the bonds after 20 years, believing that this would militate against their sale. Fifty-five per cent of the bonds are to be of $1000 denomination, 30 per cent $500 and 15 per cent $100.

FRESNO, CAL.—A change has been made in the route of the Fresno Traction Company's proposed line to the San Joaquin River. According to the new route, the line will turn east just before reaching the Riverside Country Club, and run along the top of the bluff for some distance, which will involve an extra expenditure of about $25,000. Officials of the company have signed a contract providing for the building of the line along the bluffs of the river. Chris P. Jensen, the engineer who is surveying the pipe line and compiling the maps, is rushing work on the data to be furnished the state railroad commission, and it is expected that the Fresno Traction Company will be in a position to apply to the commission for permission to build within the next week or ten days. The company is ready to start work in the early part of July. Material for the new line has already been ordered and is said to be on its way.

TELEPHONE AND TELEGRAPH.

DEMING, N. M.—The Mountain States Telephone & Telegraph Company is pushing to completion the new telephone system for the town.

PORTLAND, ORE.—Plans are being made for an eleven story and basement class A building for the Pacific Telephone & Telegraph Company, at an estimated cost of $300,000.

SEATTLE, WASH.—The new tariffs of the Pacific States Telephone & Telegraph Company for Washington have been filed with the public service commission. These tariffs cover practically every point in the state and the new rates are figured on the air line basis irrespective of the actual wire mileage used. For the first minute there is a charge of one-half cent a mile plus a five per cent terminal charge. The rate for additional minutes is one-half the first minute rate and all amounts are figured on multiples of five cents. It is presumed by the commission that the new tariffs will increase rates but it will take several weeks for communities to check up on same. It is thought however that objections will arise calling for investigation by the commission. The rates go into effect July 16.

WATERWORKS.

BURLINGAME, CAL.—The Trustees passed an order to advertise for bids for the construction of a municipal water plant in this city.

SAWTELLE, CAL.—The Santa Monica Water Company has applied for a franchise to lay pipes through the streets and alleys of Sawtelle.

BANDON, ORE.—By an overwhelming majority the voters of Bandon voted to reject the proposition for the city to purchase the Bandon waterworks for $62,000.

EL MONTE, CAL.—Engineer Brawner has filed a report of his investigation of the present water system, and estimates the cost of installing a new plant such as required for fire protection, also the purchase of the present plant, at about $20,000.

SAN FRANCISCO, CAL.—The supervisors have passed to print the new water rate ordinance, which contains the same schedule of charges now in force except for reductions in the prices provided for water furnished to shipping and for that supplied to contractors.

VALLEJO, CAL.—It has been announced that $55,000 on improvements at Mare Island will be the first money used under the new appropriation, available July 1. This will include a $25,000 salt water flushing and fire protection system and $20,000 for repairs on the seawall.

SAN BERNARDINO, CAL.—A deed, transferring the holdings of the Riverside Water Company in this county to Riverside, has been filed with County Recorder Allison. The consideration named is $575,000. Included in the property are numerous tracts of water bearing lands, pipe lines, canals and pumping plants.

VICTORIA, B. C.—Active work on the prosecution of the Sooke Lake development scheme will soon be commenced by the city under the supervision of Water Commissioner Rust, and bids will be called for an early date. The estimated cost of the materials is between $400,000 and $500,000 for the concrete pipe and $300,000 and $400,000 for the steel pipe. The concrete pipe will be used for the flow line, which will connect Sooke Lake with the proposed reservoir at Humpback, and between the reservoir and the city the steel pipe will be used for the pressure line.

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE—2 72 x 18 return tubelar boilers, brick yard type, 150 h.p. each, Hartford inspection 100 lbs. 2 Alma water tube marine boilers, 150 h.p.; tested 500 lbs.; cold water. Reynolds Electric Co., 310 1st Ave., So., Seattle, Wash.

WHERE TO BUY IT IN THE WEST

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Adapters, Lamp
Benjamin Electric Mfg. Co.
General Electric Company

Air Compressers
Fairbanks, Morse & Co.
"Smith-Vaile," Moore & Co., Chas. C.

Alarms, Burglar
Manhattan Elec. Supply Co.
Western Electric Company

Alarms, Fire
Dean Electric Co.
Western Electric Company

Arms, Cross
Western Electric Company

Anchors, Guy
Johns-Manville Co., H. W
The Ohio Brass Co.
Pacific States Electric Co.

Arms, Mast
Fort Wayne Electric Works

Asbestos
Johns-Manville Co., H. W.

Asbestos, Wood
Johns-Manville Co., H. W.

Automobile Accessories
American Ever-Ready Co.
Westinghouse Elec. & Mfg. Co.

Automobile Horns, Electric
Dean Electric Co.

Batteries, Dry
American Ever-Ready Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company

Batteries, Storage
Edison Storage Battery Supply Co.
Electric Storage Battery Co.
Westinghouse Machine Co.

Bells, Electric
Pacific States Electric Co.
Western Electric Company

Bells, Magneto
Western Electric Company

Batteries, Wet
Pacific States Electric Co.
Western Electric Company

Boilers
Fairbanks, Morse & Co.
Keystone Boiler Works
"Geary," Mach. & Elect. Co.
Parker Boiler Co.

Boxes, Conduit
Benjamin Electric Mfg. Co.
General Electric Co.
Pacific States Electric Co.

Boxes, Wall
Benjamin Electric Mfg. Co.
General Electric Company
"Multilet," Sprague Elec. Co.

Braces, Cross-Arm
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.

Brackets, Iron Pole
Pacific States Electric Co.
Pierson, Roeding Co.

Building Paper
Paraffine Paint Co., The

Cable—Flexible, armored
Sprague Electric works

Cables, Submarine and Lead-Covered
Electric Appliance Co.
General Electric Company
Habirshaw Wire Company
Indiana Rubber Co.
National Con. & Cable Co., The
Okonite Company, The
Pacific States Electric Co.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Company

Cables, Telephone
Electric Appliance Co.
Indiana Rubber Co.
Kellogg Swbd. & Supply Co.

Castings, Steel
Columbia Steel Co.

Christmas Tree Outfits
American Ever-Ready Co.
Pacific States Electric Co.

Circuit Breakers
Bowie Switch Co., The
Fort Wayne Electric Works
General Electric Company
Pacific Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Clamps, Ground
General Electric Company
Pacific States Electric Co.
Thomas & Sons Co., R.

Cleats, Porcelain
General Electric Company
Pass & Seymour, Inc.
Western Electric Company

Clusters, Fixture
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.

Coils, Armature
D. & W. Fuse Company
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Coils, Induction
Kellogg Swbd. & Supply Co.
Westinghouse E. & M. Co.

Coils, Spark
Pacific States Electric Co.
Western Electric Company
Westinghouse Elec. & Mfg. Co.

Compounds, Boiler
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Condensers
"Le Blanc" Westinghouse Machine Co.

Conduit Construction
K-P-F Electric Co.

Conduit Fittings
"V. V.," Electric Agencies Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Conduit, Flexible
"Flexduct," "Flexsteel," "National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works.

Conduit, Rigid
"Economy," "Sherarduct," National Metal Molding Co.
Pacific States Electric Co.
Sprague Electric Works

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Connectors
Manhattan Elec. Supply Co.
Westinghouse Elec. & Mfg. Co.

Controllers
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Contactors, A. C. and D. C.
General Electric Company
Westinghouse E. & M. Co.

Controllers, Drum and Dial
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Converters
Wagner Electric Mfg. Co.

Cord, Flexible Bell
General Electric Company
Westinghouse E. & M. Co.

Cord, Lamp
General Electric Company
Okonite Company, The
Pacific States Electric Co.
Sprague Electric Works
Standard Und. Cable Co.
Western Electric Company

Cord, Telephone
Kellogg Swbd. & Supply Co.
Western Electric Company

Cut-Outs, Arc
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Incandescent
D. & W. Fuse Company
General Electric Company
Westinghouse E. & M. Co.

Cut-Outs, Transformer
D. & W. Fuse Company
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Dimmers, Theater
General Electric Company
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.

Drawing Materials
Post Co., The Frederick

Drills, Electric
Fort Wayne Electric Works

Dynamos, A. C.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.

Dynamos, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Company
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co

Dynamometers
Sprague Electric Company

Elevators
Van Emon Elevator Co.

Engines, Gas and Gasoline
Fairbanks, Morse & Co.
Moore & Co., Chas. C.
Hunt, Mirk & Co.
Westinghouse Machine Co.

Engines, Oil
Fairbanks, Morse & Co.

Engines, Steam
Fairbanks, Morse & Co.
Hunt, Mirk & Co.
"Skinner," Mach. & Elect. Co.
Westinghouse Machine Co.

Fans, A. C., Portable
"Century," R. J. Davis
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fans., D. C., Portable
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Sprague Electric Works
Western Electric Company
Westinghouse E. & M. Co.

Fans, A. C., Ceiling
"Century," R. J. Davis
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Fans, D. C., Ceiling
General Electric Company
Pacific States Electric Co.
Sprague Electric Works
Westinghouse E. & M. Co.

Fans, Exhaust
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Filters, Oil
Westinghouse Elec. & Mfg. Co.

Fixtures, Ceiling, Bracket, Etc.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
Johns-Manville Co., H. W.
Pacific States Electric Co.

Fixtures, Marine
Benjamin Electric Mfg. Co.

Fixtures, Show Case
Benjamin Electric Mfg. Co.
Johns-Manville Co., H. W.

Flash Lights—Electric
American Ever-Ready Co.
Pacific States Electric Co.

ADDRESSES

Allis-Chalmers Company
San Francisco, Rialto Bldg.

Aluminum Co. of America
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

American Ever-Ready Co.
San Francisco, 755 Folsom
Seattle, Wash.
Los Angeles, Cal.

Benjamin Elec. Mfg. Co.
San Francisco, Rialto Bldg.

Blake Signal & Mfg. Co.
San Francisco, 44 Second

Bowie Switch Co., The
San Francisco, Wells Fargo National Bank Bldg.

Bridgport Brass Co.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Brill Co., The J. G.
San Francisco, 118 N. Mtg'ry
Los Angeles, Pacific Electric Bldg.
Seattle, Colman Bldg.

Century Electric Co.
San Francisco, 56 Natoma.

Columbia Steel Co.
San Francisco, 503 Market

Crocker Wheeler Co.
San Francisco, First National Bank Bldg.

Crouse-Hinds Co.
All jobbers.

Cutler-Hammer Mfg. So.
San Francisco, care of H. B. Squires, 579 Howard St.

D. & W. Fuse Co.
All Jobbers

Davis, R. J.
San Francisco, 60 Natoma

Dearborn Drug & Chem. Wks.
San Francisco, 301 Front
Los Angeles, 355 E. Second

Dean Electric Co.
San Francisco, 156 Second

Economy Electric Co.
San Francisco, 444 Market

Edison Storage Battery Supply Co.
San Francisco, 818 Mission.

Egan, A. T.
Salt Lake, Felt Bldg.

Electric Agencies Company.
San Francisco, 247 Minna

Electric Appliance Company
San Francisco, 807-9 Mission

Electric Storage Battery Co.
San Francisco, 118 N. Mtg'ry

Fairbanks, Morse & Co.
San Francisco, 651 Mission St.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.
Spokane, Wash.

Fort Wayne Elec. Wks.
San Francisco, 302 Rialto Blg.
Seattle, Colman Bldg.

General Electric Co.
San Francisco, Rialto Bldg.
Seattle, Colman Bldg.
Portland, Worcester Bldg.
Los Angeles, 124 W Fourth
Spokane, Wash., Paulsen Blg.

Habirshaw Wire Co.
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Oakland, 507 Sixteenth
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Seattle, 1518 1st Ave. So.

Hemingray Glass Co.
San Francisco, 807 Mission.
Los Angeles, 330 So. Los Angeles
Portland, 345 Oak

Holabird-Reynolds Co.
San Francisco, 527 Mission
Los Angeles, 218 E. Third
Seattle, 307 1st Ave. So.

Holophane Works of G. E. Co.
San Francisco, Aranson Bldg., 3rd and Mission Sts.

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General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Fuse, Enclosed, and Fittings
D. & W. Fuse Company
General Electric Company
Johns-Manville Co., H. W.
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Fuse, Wire and Links
General Electric Company
Pacific States Electric Co.
Pierson, Roeding & Co.

Fuses, High Tension
Pacific Electric Mfg. Co.
Pacific States Electric Co.
Pass & Seymour, Inc.

Fuses, Miscellaneous
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Westinghouse E. & M. Co.

Fuses, Telephone
D. & W. Fuse Company
Western Electric Company

Governors, Pressure
General Electric Company

Governors, Water-Wheel
Pierson, Roeding & Co.

Guards, Wire Lamp
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Simplex Electric Heating Co.
The Cutler-Hammer Mfg. Co.
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Sprague Electric Works

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Sprague Electric Works

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Pacific States Electric Co.
Western Electric Company
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Ohio Brass Company
Pacific States Electric Co.
Pierson, Roeding & Co.
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Westinghouse E. & M. Co.

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Johns-Manville Company
Ohio Brass Company
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"Victor," Pierson, Roeding & Co.
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Westinghouse E. & M. Co.

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"O. B. Hi-Tension," Holabird-Reynolds Co.
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Pass & Seymour, Inc.
Pierson, Roeding & Co.
"Pittsburg," Elec. Agen. Co.
Westinghouse E. & M. Co.

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Ohio Brass Company

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Johns-Manville Co., H. W.
Ohio Brass Company
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Pacific States Electric Co.

Lamp Standards
Pacific States Electric Co.

Lamps, Electric Arc
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Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.

Lamps, Flaming Arc
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Pacific States Electric Co.

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Electric Appliance Co.
General Electric Co.
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Pacific Lamp & Supply Co.
Packard Lamp Works.
Pacific States Electric Co.
"Star" Kendick Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.

Lamps, Miniature
American Ever-Ready Co.
Electric Appliance Co.
General Electric Company
Pacific Lamp & Supply Co.
Pacific States Electric Co.
Packard Lamp Works
Westinghouse E. & M. Co.

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Westinghouse E. & M. Co.

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Weston Elect. Inst. Co.

Meters, Ammeters and Volt
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Fort Wayne Electric Works
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Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Weston Elec. Instrument Co.

Meters, Watt
Fort Wayne Electric Works
General Electric Company
Johns-Manville Co., H. W.
Weston Electric Instmt. Co.
Westinghouse E. & M. Co.

Motors, A. C.
Allis-Chalmers Company
"Century," Single Phase, R. J. Davis, R. R. Poppleton, W. M. Price Co., A. T. Egan.
Fairbanks, Morse & Co.
General Electric Co.
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Motors, D. C.
Crocker Wheeler Co.
Fairbanks, Morse & Co.
Fort Wayne Electric Works
General Electric Co.
Sprague Electric Works
Wagner Electric Mfg. Co.
Western Electric Company
Westinghouse E. & M. Co.

Molding, Metal
Johns-Manville Co., H. W.
National Metal Molding Co.

Novelties, Electric
American Elec. Heater Co.
Manhattan Elec. Supply Co.

Oil Burners and Systems
Leahy Mfg. Co.
Staples & Pfeiffer

Ozonators
Pacific States Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paint, Insulating
Pacific States Electric Co.
Paraffine Paint Co., The
Standard Und. Cable Co.
Westinghouse Elec. & Mfg. Co.

Paints, Preservative
Nason & Co., R. N.
Paraffine Paint Co., The

Panel Boards
General Electric Company
Pacific States Electric Co.
Westinghouse E. & M. Co.

Panels, Motor Starting
General Electric Company
Westinghouse E. & M. Co.

Pins, Eucalyptus
McGlauflin Mfg. Co.
Pacific States Electric Co.

Pins, Iron
Pacific States Electric Co.
Pierson, Roeding & Company
Thomas & Sons Co., The R.
Westinghouse E. & M. Co.

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Schaw-Batcher Co.
Western Pipe & Steel Co.

Pipe Specials, The
Columbia Steel Co.
Pittsburg Piping & Equip. Co.
Schaw-Batcher Co.
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Piping Installation
Mannesmannrohren-Werke
Pittsburg Piping & Equip. Co

Plugs, Flush
General Electric Company
Pacific States Electric Co.

Plugs, Attachment
Benjamin Electric Mfg. Co.
General Electric Company
Pacific States Electric Co.
Pass & Seymour, Inc.
Westinghouse E. & M. Co.

Plugs, Stage
General Electric Company
Pacific States Electric Co.
Western Electric Company

Poles, Iron and Steel
Pierson, Roeding & Company

Poles, Wood
Western Electric Company
Pierson, Roeding & Company

Power Plants
Westinghouse-Church-Kerr Co.

Producers, Gas
Fairbanks, Morse & Co.
Westinghouse Machine Co.

Pumps, Boiler Feed
Fairbanks, Morse & Co.

Pumps, Centrifugal
Byron Jackson Iron Works.
Fairbanks, Morse & Co.

Pumps, Deep Well
Fairbanks, Morse & Co.
Simonds Machinery Co.

Pumps, Steam
Fairbanks, Morse & Co.
"Snow," Mach. & Elect. Co.

Pumps, Vacuum
Simonds Machinery Co.

Push Buttons
Pacific States Electric Co.
Western Electric Company

Rail Bonds
General Electric Company
Johns-Manville Co., H. W.
The Ohio Brass Co.
Westinghouse E. & M. Co.

Rectifiers
General Electric Company
Pacific States Electric Co.
Wagner Electric Mfg. Co.
Westinghouse E. & M. Co.

Reflectors
Holophane Works of G. E. Co.

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K-P-F Electric Co.
Westinghouse E. & M. Co.

Resistances
General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

Rheostats, Battery Charging
The Cutler-Hammer Mfg. Co.
General Electric Company
Westinghouse Elec. & Mfg. Co.

Rheostats, Field
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rheostats, Motor Starters
Fort Wayne Electric Works
General Electric Company
Westinghouse E. & M. Co.

Rock Drills
Fort Wayne Electric Works

Roofing
Paraffine Paint Co., The

ADDRESSES

Holtzer-Cabot Co.
San Francisco, 612 Howard.
Los Angeles, Union Oil Bldg.
Seattle, 1002 1st Ave (South)

Hunt, Mirk & Co.
San Francisco, 141 Second

Indiana Rub. & Ins. Wire Co.
San Francisco, 807 Mission.

Jackson, Byron, Iron Works
San Francisco, 357-361 Market
Los Angeles, 212 N. Los Angeles St.

Johns-Manville Co., H. W.
San Francisco, cor. Second and Mission Sts.
Los Angeles, 222-224 North Los Angeles
Seattle, 576 First Ave. So.

K-P-F Electric Co.
San Francisco, 37 Stevenson

Keystone Boiler Works
San Francisco, 201 Folsom

Klein & Sons, Mathias
San Francisco 579 Howard

Leahy Mfg. Co.
Los Angeles, 8th & Alameda

Machinery & Electrical Co.
Los Angeles, 351 N. Main St.

Mannesmannrohren-Werke
San Francisco, Rialto Bldg.

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Sunnyvale, Cal.

Nason & Co., R. N.
San Francisco, 151 Potrero Ave.

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Los Angeles, 1009 Trust and Savings Bldg.

New York Insl'td Wire Co.
San Francisco, 629 Howard.

Ohio Brass Co.
San Francisco, 523 Mission.
Los Angeles, 372 Pac. Elec. Bldg.
Seattle, 524 First Ave. So.

Okonite Co.
All Jobbers.

Pacific Electric Mfg. Co.
San Francisco, 80 Tehama.

Pacific Lamp & Supply Co.
Seattle, 115 Prefontaine place

Pacific States Electric Co.
San Francisco, 575 Mission.
Oakland, 526 13th St.
Los Angeles, 526 So. L. A. St.
Portland, 90-92 7th St.
Seattle, 307 1st Ave. South.

Packard Lamp Works
San Francisco, 807-9 Mission.
Seattle, 115 Prefontaine place

Parker Boiler Co.
San Francisco, 201 Folsom

Paraffine Paint Co., The
San Francisco, 34 First.

Pass & Seymour
San Francisco, Rialto Bldg.

Pelton Water Wheel Co.
San Francisco, 2219 Harrison

Pierson, Roeding & Co.
San Francisco, Rialto Bldg.
Los Angeles, 693 Pacific Electric Bldg.
Seattle, 523 Colman Bldg.
Portland, 707 Spalding Bldg.
Vancouver, 320 Pacific Bldg.

Pittsburg High Voltage In. Co.
San Francisco, 247 Minna St.
Los Angeles, 120 S. Los Angeles St.
Seattle, 115 Prefontain St.

Pittsburg Piping & Equip. Co.
San Francisco, Monadnock Bldg

Poppleton, R. R.
20 N. 12th St., Portland. Ore.

Post Co., The Frederick
San Francisco, 135 Second

Price Co., W. Montelius
Seattle, Wash.

Schaw-Batcher Co.
Sacramento, Cal., 211 J.
San Francisco, 356 Market

Simonds Machinery Co.
San Francisco, 12 Natoma.

Simplex Electric Heating Co.,
San Francisco, 612 Howard St.
Los Angeles.

Sprague Electric Works.
San Francisco, 302 Rialto Blg
Seattle, Colman Bldg.

Staples & Pfeiffer,
San Francisco, 102 Steuart.

Standard Und. Cable Co.
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg

Searchlights
Fort Wayne Electric Works
General Electric Company
Separators, Steam
Pittsburg Piping & Equip. Co.
Shades
Benjamin Elec. & Mfg. Co.
Sockets and Receptacles
Benjamin Elec. & Mfg. Co.
General Electric Company
Pacific States Electric Co.
Pass & Seymour.
The Cutler-Hammer Mfg. Co.
Johns-Manville Co., H. W.
Solder, Self-Fluxing
Kellogg Swbd. & Supply Co.
Western Electric Co.
Soldering Paste
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Westinghouse Elec. & Mfg. Co.
Surveying Instruments
Post Co., The Frederick
Staples, Insulating
Blake Signal & Mfg. Co.
Pacific States Electric Co.
Western Electric Company
Starters (Hand) D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Starters (Self), D. C. and A. C.
General Electric Company
Westinghouse E. & M. Co.
Steel Castings
Columbia Steel Co.
Street Cars
"Brill," Pierson, Roeding & Co.
Switches, Float
General Electric Company
Westinghouse E. & M. Co.
Switches, Disconnecting
General Electric Co.
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Pierson, Roeding & Company
Westinghouse E. & M. Co.
Switches, High Tension
Bowie Switch Co., The
General Electric Co.
Pierson, Roeding & Co.
Westinghouse E. & M. Co.
Switches, Knife
General Electric Company
Pacific States Electric Co.
Western Electric Company
Westinghouse E. & M. Co.
Switches, Oil
General Electric Company
Pacific Electric Mfg. Co.
Westinghouse E. & M. Co.
Switches, Pendant
General Electric Company
Pass & Seymour, Inc.
Westinghouse E. & M. Co.
Switches, Push Button
Pacific States Electric Co.
Switches, Snap
The Cutler-Hammer Mfg. Co.
Pacific States Electric Co.
Switches, Solenoid
The Cutler-Hammer Mfg. Co.
Switches, Poletop
Bowie Switch Co., The
General Electric Company
Pac. Elec. Mfg. Co.
Pacific States Electric Co.
Switchboards, Power
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Westinghouse E. & M. Co.
Switchboards, Telephone
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Western Electric Company
Tanks, Steel.
Western Pipe & Steel Co.
Tape.
General Electric Company
Johns-Manville Co., H. W.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Western Electric Co.
Telephone Equipment.
Dean Electric Co.
Kellogg Swbd. & Supply Co.
Manhattan Elec. Supply Co.
Pacific States Electric Co.
Western Electric Company
Tools, Construction.
Klein, Mathias & Sons
Pacific States Electric Co.
Pierson, Roeding & Company
Towers, Steel.
Pierson, Roeding & Company
Transformer Winding.
K-P-F Electric Co.
Transformers
Crocker-Wheeler Co
Fort Wayne Electric Works
General Electric Company
Western Electric Company
Wagner Electric Mfg. Co.
Westinghouse E. & M. Co.
Trolley Bases
Ohio Brass Co.
Pierson, Roeding & Company
Holabird-Reynolds Co.
Tubes and Bushings
Ohio Brass Company
Turbines, Steam.
General Electric Company
"Rateau," Wilson Mach. Co.
Western Electric Company
Westinghouse Machine Co.
Turbines, Water.
Pelton Water Wheel Co.
Valves
Pittsburg Piping & Equip. Co.
Vacuum Cleaners, Electric.
American Ever-Ready Co.
"Spencer Turbine," Mach. & Electrical Co.
Pacific States Electric Co.
Washing Machines
Pacific States Electric Co.
Western Electric Co.
Water Supply Systems.
Fairbanks, Morse & Co.
"Kewanee," Simonds Mchy Co.
Wire, Aluminum.
Pierson, Roeding & Company
Wire, Annun's and Office.
Standard Und. Cable Co.
Western Electric Company
Wire, Armored
General Electric Company
Sprague Electric Works
Standard Und Cable Co.
Wire, Asbestos-Covered.
D. & W. Fuse Company.
General Electric Company
Johns-Manville Co., H. W.
Western Electric Company
Wire, Bare Copper.
General Electric Company
National Con. & Cable Co., The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Enameled.
General Electric Co.
Western Electric Company
Wire, Magnet.
D. & W. Fuse Company
General Electric Company
Kellogg Swbd. & Supply Co.
Standard Und. Cable Co.
Western Electric Company
Wire, Rubber-Covered.
General Electric Company
Habirshaw Wire Company
Indiana Rubber & Ins. W. Co.
N. Y. Insulated Wire Co.
Okonite Company, The
Pacific States Electric Co.
Standard Und. Cable Co.
Wire, Trolley.
Bridgeport Brass Company
Wire, Weatherproof
General Electric Company
National Con. & Cable Co., The
Okonite Company, The
Standard Und. Cable Co.
Western Electric Company

ADDRESSES.

Thomas & Co., R.
San Francisco, 680 Folsom
Oakland, 507 Sixteenth
Los Angeles, 119 E. 7th.
Seattle, 1518 1st Ave. So.
Van Emon Elevator Co.
San Francisco, 56 Natoma.
Wagner Electric Mfg. Co.
San Francisco, Rialto Bldg.
Western Electric Co.
San Francisco, 680 Folsom St.
Oakland, Cal.
Los Angeles, Cal.
Western Electric Company
Western Pipe & Steel Co.
San Francisco, 444 Market
Los Angeles, 1758 W. Broadway
Westinghouse E. & M. Co.
Denver, 1052 Gas & Elec. Bldg.
Los Angeles, 811 I. N. Van Nuys Bldg.
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 Second
Spokane, Paulsen Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Westinghouse Machine Co.
San Francisco, 141 Second
Westinghouse-Church-Kerr Co.
San Francisco, 839 Pacific Bldg
Los Angeles, Cal., Pacific Electric Bldg.
Weston Elec. Instrument Co.
San Francisco, 682-684 Mission
Wilson Machinery Co.
San Francisco, 361 Market

CUTLER-HAMMER

LIKE A SECTIONAL BOOKCASE

Cutler-Hammer Battery Charging Rheostats Provide for the Future

The following installation data shows how the American Express Co., South Boston Station, began with four rheostats and now have 42:

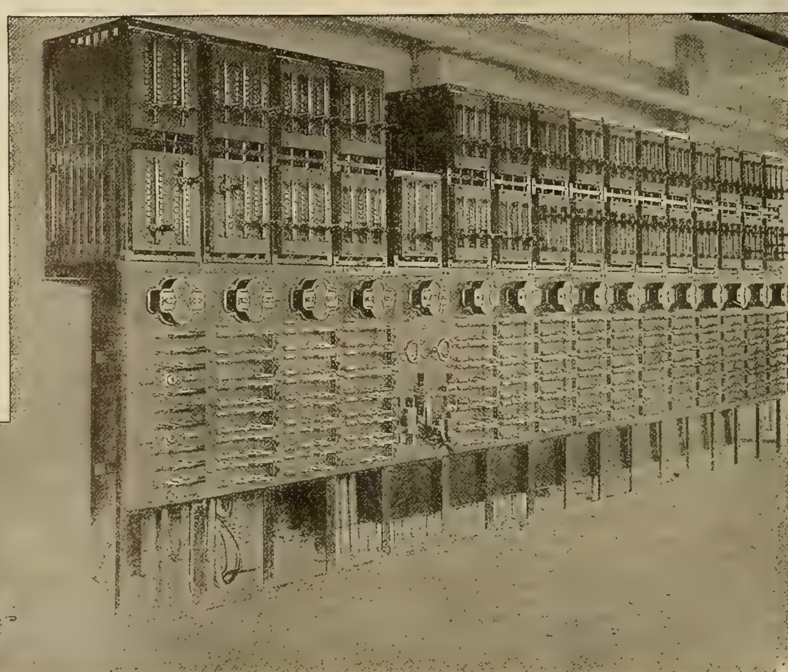
December,	1911,	installed	1 six-circuit panel,	4 rheostats
April,	1912,	installed		2 rheostats
August,	1912,	installed	1 six-circuit panel,	6 rheostats
November,	1912,	installed	1 six-circuit panel,	6 rheostats
January,	1913,	installed	4 six-circuit panels,	24 rheostats
Total...............			7 six-circuit panels,	42 rheostats

The above shows how, with Cutler-Hammer rheostats, provision is made for growth. Only four rheostats were first installed, but in little over a year this equipment was increased a thousand per cent. It looks the same as if it had been installed at one time.

The fact that more Cutler-Hammer rheostats were ordered as more electric trucks were used is a silent but strong testimonial to their satisfactory operation.

You'll have to add to the charging equipment in the garage you have or are contemplating. Start right,—by ordering Cutler-Hammer charging equipment, — you will insure satisfactory charging for the present, and for the future.

Put your proposition up to us and the C-H Messenger Boy will rush information and Bulletins to you promptly.



THE CUTLER-HAMMER MFG. CO. MILWAUKEE

PACIFIC COAST AGENTS: H. B. Squires Co., 579 Howard St., SAN FRANCISCO. 229 Sherlock Building, PORTLAND, ORE. and W. B. Palmer, 416 East 3rd St., LOS ANGELES.